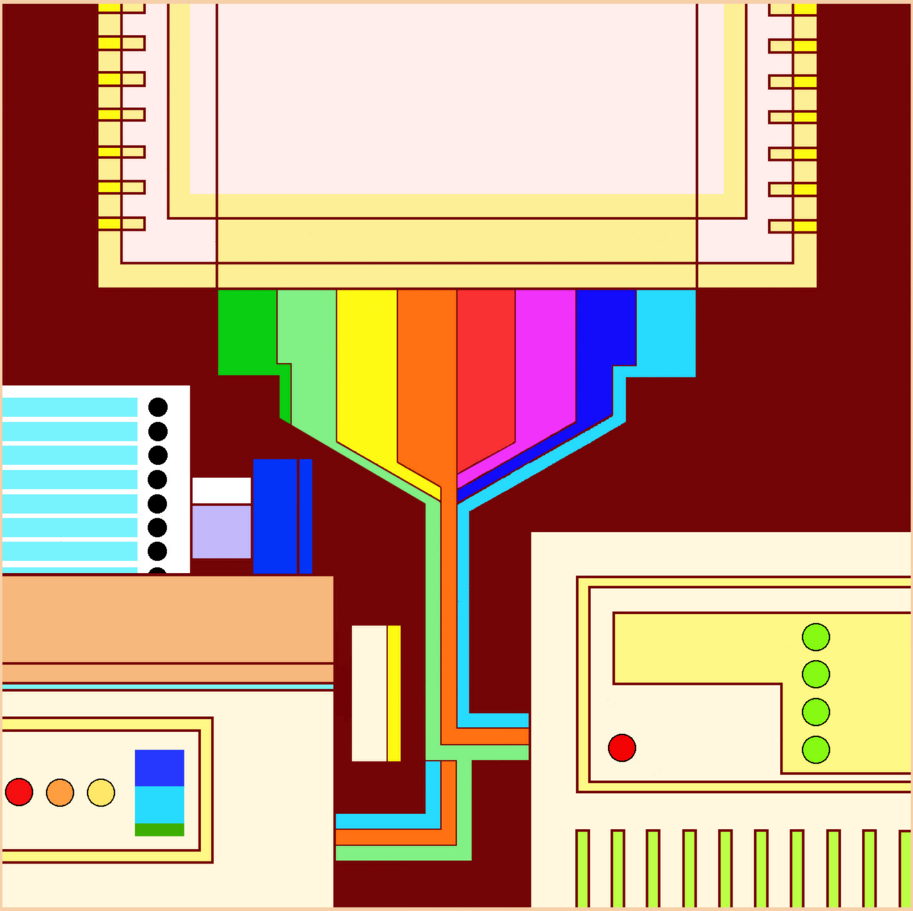
Apple II

# Super Serial Card

## Installation and Operating Manual



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**WARNING: This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to this computer. Operation with non-certified peripherals is likely to result in interference to radio and TV reception.**

Apple II

# Super Serial Card

## Installation and Operating Manual

**Please read this manual before attempting to install the Super Serial Card in the Apple Computer. Incorrect installation could cause permanent damage to both the Super Serial Card and the Apple.**

# RADIO AND TELEVISION INTERFERENCE

The equipment described in this manual generates and uses radio frequency energy. If it is not installed and used properly, that is in strict accordance with our instructions, it may cause interference to radio and television reception.

This equipment has been tested and complies with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules. These rules are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that the interference will not occur in a particular installation.

You can determine whether your computer is causing interference by turning it off. If the interference stops, it was probably caused by the computer. If your computer does cause interference to radio or television reception, you can try to correct the interference by using one or more of the following measures:

- Turn the TV or radio antenna until the interference stops.

- Move the computer to one side or the other of the TV or radio.

- Move the computer farther away from the TV or radio.

- Plug the computer into an outlet that is on a different circuit from the TV or radio. (That is, make certain the computer and the TV or radio are on circuits controlled by different circuit breakers or fuses.)

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems"

This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock number 004-000-00345-4.

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# TABLE OF CONTENTS

**PREFACE** vii

Chapter 1
**GETTING STARTED** 1

1 Unpacking
2 A Close Look
2 Preparing Cable and Clamp Assembly
3 Attaching Internal Cable to SSC

Chapter 2
**PRINTER MODE** 5

5 Preparing the SSC for Printer Mode
6 Setting the Switches
6   Commonly Used Settings
6   Baud Rate
7   Data Format and Parity
7   Carriage Return Delay
8   Line Width and Video On/Off
8   Generate <LF> Out
8   Special Switches
9 Installation Procedure
10   External Cable and Connector
11 Using the SSC in Printer Mode
11   With a Printer
11   With a Terminal
11 Printer Mode Commands
12   Command Formats
12   The Command Character
13   Printer Mode Command Summary
15   Commands That Change Switch Settings
15     Baud Rate--<n>B
15     Data Format--<n>D
15     Parity--<n>P
16     Set Time Delay--<n>C, <n>L, <n>F
17     Generate <CR> On Column Overflow--C
17     Generate <LF> Out--L_<E/D>
17     Mask (Suppress) <LF> In--M_<E/D>
17     Reset the SSC--R

17 Other Commands
18 Translate Lowercase Characters--<n>T
18 Zap (Suppress) Control Characters--Z
18 Find Keyboard--F_<E/D>
18 XOFF Recognition--X_<E/D>
19 Tab in BASIC--T_<E/D>

## Chapter 3
## COMMUNICATIONS MODE 21

21 Preparing the SSC for Communications Mode
22 Setting the Switches
22 Commonly Used Settings
22 Baud Rate
23 Data Format and Parity
24 Generate <LF> Out
24 Special Switches
24 Installation Procedure
26 External Cable and Connector
26 Using the SSC in Communications Mode
27 Communications Mode Commands
27 Command Formats
28 The Command Character
28 Communications Mode Command Summary
30 Commands That Change Switch Settings
30 Baud Rate--<n>B
30 Data Format--<n>D
30 Parity--<n>P
31 Generate <LF> Out--L_<E/D>
31 Mask (Suppress) <LF> In--M_<E/D>
31 Reset the SSC--R
31 Other Commands
32 Set Time Delays--<n>C, <n>L, <n>F
32 Translate Lowercase Characters--<n>T
33 Zap (Suppress) Control Characters--Z
33 Find Keyboard--F_<E/D>
33 XOFF Recognition--X_<E/D>
34 Specify Screen Slot--<n>S
34 Echo Characters on the Screen--E_<E/D>
34 Terminal Mode
35 Terminal Mode Commands
35 Enter Terminal Mode--T
36 Transmit a Break Signal--B
36 Special Characters--S_<E/D>
36 Quit (Exit from) Terminal Mode--Q
36 A Terminal Mode Example

## Chapter 4

# HOW THE SSC WORKS 37

37 Serial Data Communication
38   Parallel Data in the Apple II
39   Serial Data for Long Distances
39   Data Conversion
40   RS-232-C Data Formats
40   RS-232-C Signals
41     Modems
42     Modem Eliminators
43 SSC Modes and Configurations
45 Theory of Operation
46   Addressing and Control Logic
46     ROM/RAM Space
47     Registers in Peripheral I/O Space
47   The ACIA
48   Data Input and Output
48   Data Bus
48   Jumper Block

## Appendix A

# FIRMWARE 49

49 Pascal 1.1 Firmware Protocol
50   I/O Routine Entry Points
51   Device Identification
52 SSC Firmware Memory Usage
52   Zero Page Locations
53   Scratchpad RAM Locations
54   Peripheral Card I/O Space
55 SSC Entry Points
55   Monitor ROM Entry Points
55   BASIC Entry Points
56   Pascal 1.0 Entry Points
56   Pascal 1.1 Entry Points
57   Other Special Firmware Locations
58 SSC Firmware Listings

## Appendix B

# APPLE INTERFACE CARD EMULATION 91

91 Old Serial Interface Card Emulation
92   P8 Emulation POKEs
94   P8A Emulation POKEs
95   Other Emulation Mode Differences

96 Old Communications Card Commands
96 Switch to Terminal Mode--<CTRL-T>
96 Bypass Terminal Mode--<CTRL-R>
96 XOFF--<CTRL-S>
96 Parallel Card Commands
96 Line Width n and Video Off--<CTRL-I><n>N
96 Line Width 40 and Video On--<CTRL-I>I
96 Disable Automatic Linefeed--<CTRL-I>K

Appendix C
SPECIFICATIONS AND SCHEMATICS 97

97 SSC Specifications
98 Connector Pin Assignments
99 Jumper Block Wiring
100 Schematic Diagram

Appendix D
ASCII CODE TABLE 101

Appendix E
TROUBLESHOOTING HINTS 105

Appendix F
ERROR CODES 109

GLOSSARY 111

FIGURES AND TABLES 119

INDEX 123

# PREFACE

The Super Serial Card (SSC) provides a two-way serial interface to a wide variety of devices, including printers, terminals, plotters, and other computers. All these devices can be connected to the SSC either directly or via modem.

The SSC replaces both the P8 and P8A variety of Apple II Serial Interface Card, although it does not manipulate all specific Apple II memory locations in the same way. The SSC also replaces the Apple II Communications Card, and supports Terminal Mode. Finally, the SSC supports Apple II parallel interface card software commands.

The Super Serial Card conforms to the Electronic Industries Association (EIA) interface definitions A through E. (To obtain a copy of the EIA RS-232-C Standard, write to the EIA Engineering Department, Electronics Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006.)

The SSC can be configured to the attached external device in three ways: (1) by setting switches on the card itself, (2) by typing in commands at the keyboard under the Monitor, Integer BASIC, Applesoft or DOS, or (3) by issuing commands from assembly language, BASIC or Pascal programs. The SSC can be configured and operated by programs in Integer BASIC, APPLESOFT, Pascal, and assembly language.

How you prepare, install and use the Super Serial Card depends on what you connect to it:

- Read Chapter 1 for unpacking and cable clamp preparation instructions.

- If you are going to connect a printer, terminal or some other device directly to the SSC, then read the first four sections of Chapter 2. (Many commonly used switch settings are listed in Table 2-1 for your convenience.) You only need to read the section Printer Mode Commands of Chapter 2 if you need special commands to change the SSC's characteristics.

- If you are going to connect a device to the SSC via a modem or similar communications equipment, then read the first four sections of Chapter 3. (Switch settings for many Communications Mode applications are listed in Table 3-1.) You only need to read the section Communications Mode Commands of Chapter 3 if you need special commands to change the SSC's characteristics.

- If you want to use the Apple II as an unintelligent terminal connected via a modem, read the section Terminal Mode of Chapter 3.

- Troubleshooting Hints are discussed in Appendix E.

The SSC also emulates ("imitates") the Apple II Serial Interface Card (both the P8 and P8A varieties), and supports many of the software commands used by the Apple II parallel printer interface card and the Apple II Communications Card. These are all discussed in Appendix B.

Chapter 4 explains how the SSC works, both in everyday terms (Serial Data Communication Simply Explained) and from an engineering viewpoint (Theory of Operation). The Theory of Operation section is keyed to the schematic diagram in Appendix C. Chapter 4 also contains a section on SSC modes and configurations.

Appendix A discusses SSC firmware and its entry points in the SSC ROM, as well as the Apple II memory locations the firmware uses.

Appendix C contains SSC specifications and connector pin assignments, and its schematic diagram.

Appendix D lists the ASCII codes and their equivalents. Appendix E has troubleshooting hints. Appendix F explains the SSC error codes.

A glossary explains the meaning of most important terms as they apply to the SSC.

The Reference Card summarizes the switch settings and commands for the SSC Printer Mode and Communications Mode.

There are three symbols that set off information of special importance:

☞ This symbol points to a paragraph that contains especially useful information.

👁 Watch out! This symbol precedes a paragraph that warns you to be careful.

✋ This symbol precedes a warning that you are about to harm hardware or destroy data.

# CHAPTER 1

# GETTING STARTED

This chapter takes you through the first steps of getting acquainted with your Super Serial Card (SSC). After unpacking the SSC and examining it, you will assemble the short internal cable (if it is not already assembled) that connects the 10-pin cable socket on the SSC to the 25-pin socket at the back of the Apple II case.

## UNPACKING

As you unpack your Super Serial Card (Figure 1-1), check the contents against the items described on the packing list.

Fill out the pre-addressed warranty card and mail it in. If any items are missing, contact the dealer you purchased the SSC from.

You will need a shielded external cable (not provided as part of the SSC package) to connect the external device--the printer, modem, terminal, or other computer--to your Apple II. Suitable cables are available through your Apple dealer.

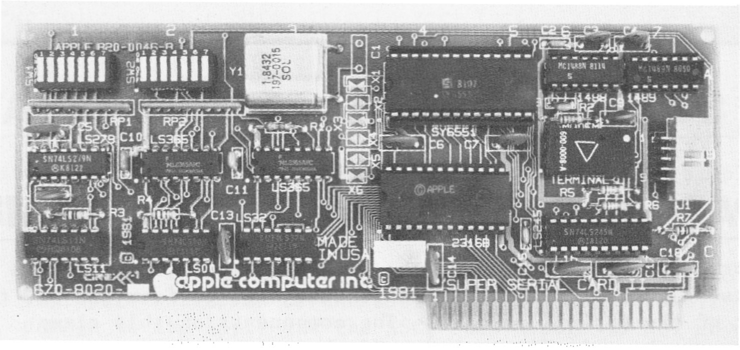


Figure 1-1. Photo of the Super Serial Card

# A CLOSE LOOK

Let's examine the Super Serial Card for a moment. Pick up the SSC carefully and put it on a flat surface oriented as shown in Figure 1-1. Now use Figure 1-2 to help identify the chief parts of the SSC. Those that you will have to deal with as you prepare it for installation are:

- The jumper block. This ordinarily points toward the word TERMINAL; if you attach a modem to the SSC, you will turn this around so the arrow points toward the word MODEM (Chapter 3).
- The switches. The left group is numbered from SW1-1 through SW1-7; the right group is numbered from SW2-1 through SW2-7. You can see the characters "SW1" and "SW2" printed on the SSC.
- The edge connector. It is important not to touch the gold fingers on this connector: they must make a clean electrical contact in the Apple II connector slot when you install the SSC (Chapter 2 or Chapter 3).
- The cable socket. The next section of this chapter explains how to install the short internal cable between the SSC and the Apple II case.

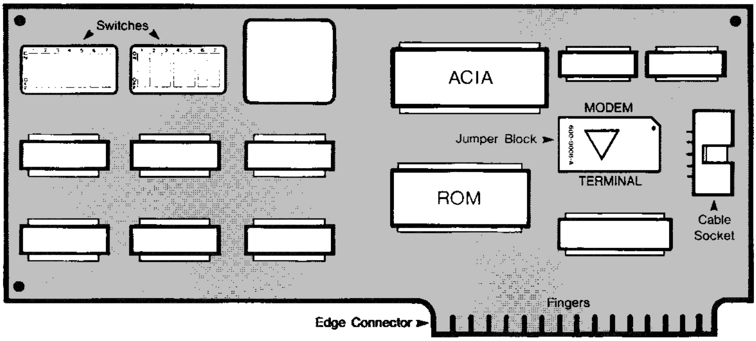


Figure 1-2. Line Drawing of the SSC

# PREPARING CABLE AND CLAMP ASSEMBLY

Before preparing and installing the SSC, you may need to prepare the clamp assembly for the internal cable that will go from the SSC to the back of the Apple II's case. The components of this clamp assembly are shown in Figure 1-3. If these components are already assembled, skip to the next section, Attaching the Internal Cable to the SSC.

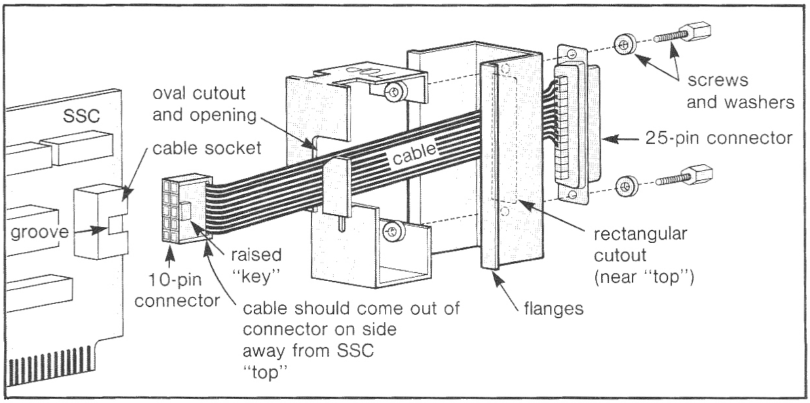

SSC
oval cutout
and opening
cable socket
groove
raised
"key"
10-pin
connector
cable should come out of
connector on side
away from SSC
"top"
cable
flanges
rectangular
cutout
(near "top")
screws
and washers
25-pin connector

Figure 1-3. Components of Internal Cable and Clamp Assembly

Lay the short cable down as shown in Figure 1-3. Pick up the clamp piece that has the word TOP stamped on one end. Hold this clamp piece with the word TOP facing away from you, and the oval cutout toward the smaller connector on the cable. Bend the cable slightly, and insert it into the oval cutout through the opening; then straighten the cable in the cutout so that it moves easily.

The other clamp piece has flanges (Figure 1-3) and a rectangular opening that is closer to one end (its top end) than to the other. Hold this clamp piece with its top end away from you and its flanges facing the 25-pin connector end of the cable. Then tilt the connector and feed it completely through the rectangular cutout.

Now slide the two clamp pieces all the way down the cable until they are right up against the 25-pin connector, and their screw holes line up with the connector's screw holes. Slide the washers onto the screws and then thread the screws a couple of turns into the lined-up holes. Don't screw them in very far.

## ATTACHING INTERNAL CABLE TO SCC

This step in the preparation of your Super Serial Card is simple to do, but you must do it carefully.

It is very important to connect the cable to the SSC correctly. Improper connection of the cable to the SSC may result in damage to the Apple and the SSC; such damage is NOT covered by your warranty.

Lay the SSC down on a flat surface, component-side up and gold fingers at the lower right. Examine the 10-pin end of the cable: the wires come out of the SIDE of the connector--the same side as the raised "key" in the plastic (Figure 1-3). Hold the connector so the wires are on the side away from the SSC, and insert the connector firmly into the cable socket along the right edge of the SSC. The raised "key" should slide into the groove in the cable socket (Figure 1-4).

If the cable is now jammed between the 10-pin cable socket and the SSC board, the connector is plugged in backwards. Unplug the connector and reconnect it so that the cable is on the side AWAY from the SSC (Figure 1-5).

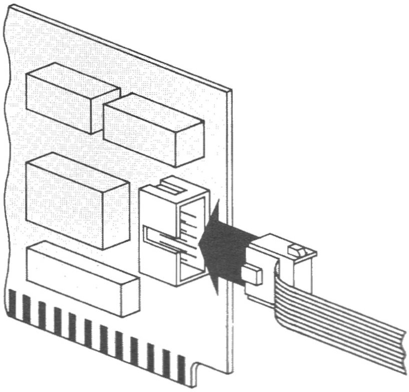


Figure 1-4. Sliding the "Key" into the Groove

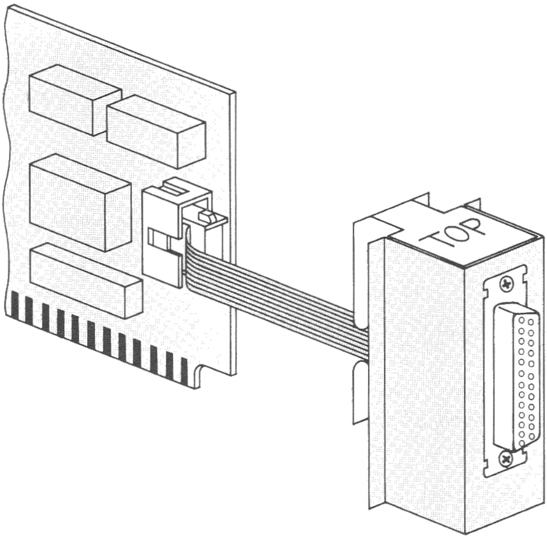


Figure 1-5. Internal Cable Attached Correctly to SSC

# CHAPTER 2

# PRINTER MODE

This chapter explains how to prepare, install and use the SSC in Printer Mode, and change the SSC's activities via commands.

## PREPARING THE SSC FOR PRINTER MODE

The SSC is ready to operate in Printer Mode when the jumper block and switches SW1-5 and SW1-6 are correctly positioned (Figure 2-1).

If the triangle on the jumper block is pointing down toward the word MODEM, remove the block (using an IC Extractor, if necessary) and carefully reinsert it so the triangle is pointing toward TERMINAL.

Using a pointed object, set switch SW1-5 OFF and switch SW1-6 ON as shown in Figure 2-1.

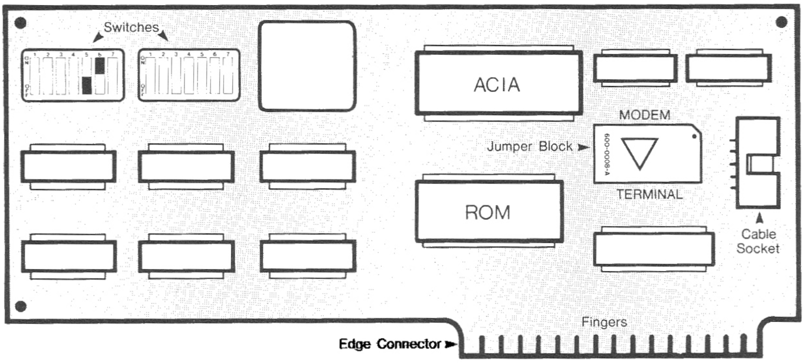


Figure 2-1. SSC Set for Printer Mode

When the jumper block is pointing toward TERMINAL, it is acting as a Modem Eliminator. Therefore, DO NOT connect a separate Modem Eliminator, or it will cancel the effect of the jumper block, and the attached device will not work.

# SETTING THE SWITCHES

Use a pointed object, such as the tip of a ballpoint pen, to flip the appropriate tiny switches on the SSC. A switch is ON when the top of the switch rocker is pushed in, and OFF when the bottom is in. The following subsections explain what settings to use.

## COMMONLY USED SETTINGS

Table 2-1 lists the switch settings you can use for direct connection, via the SSC, of some commonly used printers. Most printers can use any one of several setups.

| Printer | Switch Settings. Cable Connections. Other Information |
|---|---|
| IDS 560 Paper Tiger | SW1: OFF OFF OFF ON OFF ON ON SW2: ON ON * * OFF OFF OFF<br>Printer Mode, HW Hndshk, 9600 baud, 1 stop bit, ** width<br>IDS SW1: - - - ON ON OFF OFF SW2: - - - - OFF - -<br>SSC/IDS pins: 3/3, 7/7, 20/20; all IDS jumpers removed |
| NEC 5510 Spinwriter | SW1: OFF ON ON ON OFF OFF OFF SW2: ON ON * * OFF OFF ON<br>P8A Mode, ETX/ACK, 1200 baud, 1 stop bit, ** line width<br>NEC switches: OFF ON OFF OFF OFF OFF ON ON<br>SSC/NEC pins: 2/2, 3/3, 7/7, 20/6&8; 4&5 tied on NEC end<br>May need keystroke to force first ETX after power-up. |
| NEC 5510 Spinwriter | SW1: OFF ON ON ON OFF ON OFF SW2: ON ON * * OFF OFF ON<br>Printer Mode, hardware handshake, rest same as above<br>NEC switches: OFF ON OFF OFF OFF OFF ON ON<br>SSC/NEC pins: 3/3, 6/6&8, 7/7, 20/20; 4&5 NOT tied |
| Qume Sprint 5 | SW1: OFF ON ON ON OFF ON ON SW2: ON OFF * * OFF OFF OFF<br>Printer Mode, HW Hndshk, 1200 baud, 1 stop bit, ** width<br>Qume switches: 1200 baud, no modem; pins: 3, 4, 7, 20<br>Qume asserts RTS and DTR only when ready to receive data |
| Qume Sprint 9/35 | SW1: OFF OFF OFF ON OFF ON ON SW2: ON OFF * * OFF OFF OFF<br>Printer Mode, HW Hndshk, 9600 baud, 1 stop bit, ** width<br>Qume ETX-ACK/XON-XOFF switch set to ETX-ACK for HW Hndshk |

Table 2-1. Commonly Used Switch Settings for Printer Mode

## BAUD RATE

No matter what type of printer or terminal you connect to the SSC, the SSC is going to pass information between the Apple II and the device at a certain prearranged speed, called the baud rate. Since the Apple II can usually send and receive information faster than what is connected to it, the simplest way to determine the baud rate is to consult the user manual for the device you will connect. Find out what rate is the fastest the device can handle (up to 19,200 baud). Once you know this, you are ready to set the baud rate switches on the SSC.

| Baud | SW1-1 | SW1-2 | SW1-3 | SW1-4 | Baud | SW1-1 | SW1-2 | SW1-3 | SW1-4 |
|---|---|---|---|---|---|---|---|---|---|
| 50 | ON | ON | ON | OFF | 1200 | OFF | ON | ON | ON |
| 75 | ON | ON | OFF | ON | 1800 | OFF | ON | ON | OFF |
| 110* | ON | ON | OFF | OFF | 2400 | OFF | ON | OFF | ON |
| 135** | ON | OFF | ON | ON | 3600 | OFF | ON | OFF | OFF |
| 150 | ON | OFF | ON | OFF | 4800 | OFF | OFF | ON | ON |
| 300 | ON | OFF | OFF | ON | 7200 | OFF | OFF | ON | OFF |
| 600 | ON | OFF | OFF | OFF | 9600 | OFF | OFF | OFF | ON |
| (* 109.92) |  | (** 134.58) |  |  | 19200 | OFF | OFF | OFF | OFF |

Table 2-2. Baud Rate Switch Settings

Make sure the printer or terminal you connect is set (with its own switches, dials or thumb wheels) to the SAME baud rate! If you don't, the SSC will send and receive unrecognizable garbage.

## DATA FORMAT AND PARITY

The SSC sends each character (such as a "3" or an "F" or a Carriage Return) as a string of zeroes and ones (bits). The way it can send a character in Printer Mode, using switch settings, is this:

- first a single start bit to signal to the printer or terminal that a character is coming;
- then a string of 8 data bits representing the character;
- no error-checking parity bit;
- one or two stop bits to signal the end of a character.

For Printer Mode, the only aspect of the data format you can change with switch settings is whether to send one stop bit or two. If you set the baud rate switches to 50, 75 or 110 baud, set switch SW2-1 OFF (two stop bits). For all other baud rates, set switch SW2-1 ON (one stop bit) unless the documentation for the device you are connecting specifies otherwise.

The SSC does not send or check parity bits in Printer Mode unless you select some parity using the <n>P command, explained later in this chapter.

## CARRIAGE RETURN DELAY

If you connect a slow printer to the SSC, and it has no handshaking capability, you may need to set switch SW2-2 ON to cause the Apple II to wait 1/4 second after a Carriage Return (<CR>). This gives the print head assembly time to reposition to the beginning of the next line. Otherwise, set switch SW2-2 OFF (no delay).

Additional delay values (32 ms and 2 s) are available via the <n>C command described later in this chapter.

## LINE WIDTH AND VIDEO ON/OFF

Switches SW2-3 and SW2-4 determine the printer or terminal line width and also turn the Apple II video screen on or off.

If you are connecting a printer to the SSC, select the appropriate switch settings for the number of characters the printer can fit on a line. If you set the line width to 40, the Apple II video screen is turned on, since it too can display 40 characters per line, and so can display an exact replica of what is being printed.

If you plan to connect a terminal to the SSC, set the switches for the number of characters the terminal screen can display on a line--usually 72 or 80. For these line widths, the Apple II video screen is off.

| Line Width | Video Screen | SW2-3 | SW2-4 |
|---|---|---|---|
| 40 char/line | on | ON | ON |
| 72 char/line | off | ON | OFF |
| 80 char/line | off | OFF | ON |
| 132 char/line | off | OFF | OFF |

Table 2-3. Line Width and Video Switch Settings

The switch settings that turn off the Apple II video screen take effect only after PR# under BASIC or DOS. <CTRL-I> commands are still recognized, and cause the message APPLE SSC: to appear on the Apple II video screen.

## GENERATE ⟨LF⟩ OUT

If you are connecting a printer to the SSC, check the printer's user manual to see if it automatically generates a linefeed (<LF>) after a carriage return (<CR>). If it does not, set switch SW2-5 ON.

If your printer does automatically generate a linefeed after a carriage return, or if you are connecting some other device that does not need automatic linefeed generation, set switch SW2-5 OFF.

## SPECIAL SWITCHES

Switch SW2-6 controls forwarding of interrupts to the Apple II. Since the Apple II and II+ do not handle interrupts, set SW2-6 OFF.

Normally, switch SW1-7 is ON and switch SW2-7 is OFF. In the rare cases where the device uses pin 19, Secondary Clear To Send, in place of pin 4 or 20, Clear To Send, set SW1-7 OFF and SW2-7 ON.

Your Super Serial Card is now ready to install and use in Printer Mode.

# INSTALLATION PROCEDURE

This section explains how to install the SSC and its internal cable in the Apple II. If the cable clamp is not already assembled, do so now, following the instructions given in Chapter 1.

Before connecting or disconnecting anything on the Apple, turn off the power with the switch at the back left corner of the Apple case. THIS IS ABSOLUTELY NECESSARY. If you try to connect or disconnect anything from the inside of your Apple when the power is on, you are likely to damage the circuits.

Do not unplug the Apple, just turn it off. If you unplug the Apple, you will isolate it from earth ground and leave it vulnerable to static discharges.

Remove the Apple cover by pulling up on the two back corners of the cover until the two corner fasteners pop apart. Slide the cover back until it is free of the case and then lift the cover off.

Look inside the Apple and locate the power supply case--the rectangular metal box along the left inside the Apple II. To avoid damaging the SSC, touch the power supply case with one hand; this discharges any static charge that may be on your clothes or body.

Along the back inside edge of the Apple you will see eight long narrow slots called connector slots. The connector slots are numbered from 0 at the left to 7 at the right. The numbers are printed along the back edge behind the connector slots. For use with Pascal, install the SSC in slot #1 for a printer, or slot #3 for a terminal. For use with BASIC, install the SSC in any slot from #1 through #7.

Handle the Super Serial Card as you would handle an expensive phonograph record. Grasp it only by the corners or edges, and do not touch the components or pins, especially the gold fingers on the edge connector.

There are three deep notches along the back of the Apple II case. Temporarily set the SSC down near the desired slot. Then take the clamp assembly and slide it down into the notch closest to the slot that the SSC will be in. Tighten the screws until the connector assembly can no longer be moved in the opening.

Grasp the upper corners of the SSC and insert the gold fingers of the edge connector into the slot in the back of the Apple, rear edge first. Gently push the front edge of the card down until it is level and firmly seated.

Note that the outer ends of the screws in the clamp assembly can act as nuts. They are threaded and can receive screws from the printer or terminal connector, to ensure a good connection with the Apple.

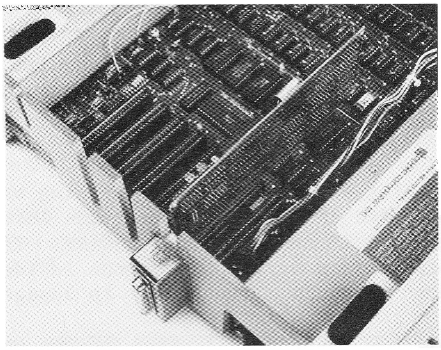


Figure 2-2. SSC in Slot #1 and Clamp Assembly in Notch

Slide the Apple case top plate in place and press down on the rear corners until the corner fasteners pop into place. The Super Serial Card is now installed.

## EXTERNAL CABLE AND CONNECTOR

The SSC cable connector you installed in the notch is a standard DB-25 connector with 25 pins. Ten pins of the connector are connected internally to the SSC. Connector pin assignments are listed in Appendix C.

You will need a cable to connect your external device to the SSC connector on the Apple II. Shielded cables with 25-pin connectors on one end are available from your Apple dealer.

The cable must have internal shielding, with the shielding properly terminated at both ends, to prevent electromagnetic interference to nearby radios, television sets, and communication equipment. This shielding is necessary for the system to comply with Class B Federal Communications Commission limits as defined by Subpart J of Part 15 of the FCC rules. Unshielded cables are not recommended.

Make sure that all devices are connected to the same grounded AC power circuit (three-wire wall outlet) as the Apple II. Connecting ungrounded equipment to your Apple II can cause severe electrical damage.

# USING THE SSC IN PRINTER MODE

Printer Mode allows you to use the SSC with a local (that is, directly connected) printer or terminal, as well as other local serial devices. After installing the SSC, you can control its operation from a BASIC, Pascal or assembly-language program, or even directly from the keyboard. The two parts of this section explain the easiest way to get the SSC up and running from the keyboard with a printer or terminal.

## WITH A PRINTER

To use the SSC with a printer, do the following:

- Make sure the jumper block points toward TERMINAL.
- Under BASIC or DOS, boot the Apple II and then type in PR#s to send output to the printer (with the SSC in slot s).
- Under Pascal, boot the Apple II and then use the F(iler T(ransfer command to send output data to #6: or PRINTER: (with the SSC in slot #1).
- If the printer doesn't work, refer to Appendix E for troubleshooting hints, or consult your Apple dealer.

## WITH A TERMINAL

To use the SSC with a terminal, do the following:

- Make sure the jumper block points toward TERMINAL.
- Under BASIC or DOS, boot the Apple II and then type in PR#s and IN#s to route both input and output through the terminal (with the SSC in slot #s).
- Under Pascal, boot the Apple II and then use the terminal as the input/output console (with the SSC in slot #3).
- If the terminal doesn't work, refer to Appendix E for troubleshooting hints, or consult your Apple dealer.

# PRINTER MODE COMMANDS

You can issue any of the commands described in this section by embedding them in a computer program. Under BASIC, DOS or the Apple Monitor, you can also enter them directly at the Apple (or terminal) keyboard.

In a BASIC program, put the control character and command in a PRINT statement. In a Pascal program, issue the command in a WRITE or WRITELN statement.

When you enter the command character (usually <CTRL-I>; see below), the prompting message APPLE SSC: appears on the display screen. Subsequent characters, up to <RETURN>, will be interpreted as an SSC command. Pressing the left arrow key before pressing <RETURN> cancels the command and causes the APPLE SSC: prompt to reappear.

Many of these commands override the physical switch settings on the SSC. This makes it unnecessary to open the Apple II case and manually flip the SSC switches. To change the values back to the physical switch settings, reboot or reset the Apple II, or type in the Reset command described below.

## COMMAND FORMATS

All commands are preceded by the Printer Mode command character (usually <CTRL-I>, see below) and followed by <RETURN>. The notation <CTRL-I> means "hold down the CTRL key while pressing I." There are three types of command formats:

- a number <n> followed by an uppercase letter (for example, 4D to set Data Format 4)
- simply an uppercase letter (for example, R to Reset the SSC)
- an uppercase letter followed by a space and then either E to Enable or D to Disable a feature (for example, L D to Disable automatic generation of linefeed characters)

The allowable range of <n> is given in each command description (next section). The choice of Enable or Disable is indicated as <E/D>.

The underscore character (_) before the <E/D> in Enable/Disable commands is merely a reminder that a space is required there.

The SSC checks only numbers and the first letters of commands and options. All such letters must be uppercase. Further letters, which you can add to assist your memory, have no effect on the SSC For example, X(OFF E(nable is the same as X E. The SSC ignores invalid commands.

## THE COMMAND CHARACTER

The normal command character in Printer Mode is <CTRL-I> (decimal 9; Appendix D). You can send the command character itself through the SSC by typing it twice in a row: <CTRL-I><CTRL-I>; no <RETURN> is required after this command. This special command allows you to transmit the command character without affecting the operation of the SSC, and without having to change to another command character and then back again later.

If you want to change the command character from <CTRL-I> to <CTRL-something else>, type <CTRL-I><CTRL-something else>. For example, to change the command character to <CTRL-W>, type <CTRL-I><CTRL-W>. To change back, type <CTRL-W><CTRL-I>. No <RETURN> is required after either of these commands.

The command character <CTRL-I> is ASCII code 9. Here is how to generate this character in BASIC and Pascal:

```
Integer BASIC:     PRINT "*command"  *embedded <CTRL-I>
Applesoft BASIC:   PRINT CHR$(9): "command"
Pascal:            WRITELN (CHR(9),'command');
```

## PRINTER MODE COMMAND SUMMARY

Table 2-4 is a summary of the commands available in Printer Mode. Some details, explained fully in the remainder of this chapter, have been omitted from the table for the sake of brevity. Commands marked with an asterisk are not supported by Pascal.

| Format | Command Name | Values | Interpretation |
|---|---|---|---|
| <n>B | Baud Rate | 0 - 15 | see Table 2-5 |
| <n>C | <CR> Delay | 0 | no delay |
| | | 1 | 32 milliseconds |
| | | 2 | 250 milliseconds (1/4 s) |
| | | 3 | 2 seconds |
| <n>D | Data Format | 0 | 8 data bits, 1 stop bit |
| | | 1 | 7 data bits, 1 stop bit |
| | | 2 | 6 data bits, 1 stop bit |
| | | 3 | 5 data bits, 1 stop bit |
| | | 4 | 8 data bits, 2 stop bits |
| | | 5 | 7 data bits, 2 stop bits |
| | | 6 | 6 data bits, 2 stop bits |
| | | 7 | 5 data bits, 2 stop bits |
| <n>F | <FF> Delay | 0 | no delay (default) |
| | | 1 | 32 milliseconds |
| | | 2 | 250 milliseconds (1/4 s) |
| | | 3 | 2 seconds |
| <n>L | <LF> Delay | 0 | no delay (default) |
| | | 1 | 32 milliseconds |
| | | 2 | 250 milliseconds (1/4 s) |
| | | 3 | 2 seconds |
| <n>P | Parity | 0,2,4,6 | no parity (default = 0P) |
| | | 1 | odd parity |
| | | 3 | even parity |
| | | 5 | MARK (parity bit always 1) |
| | | 7 | SPACE (parity bit always 0) |
| * <n>T | Translate Lowercase (LC) | 0 | change LC to UC (default) |
| | | 1 | leave LC (possible garbage) |
| | | 2 | LC to UC inverse; leave UC |
| | | 3 | LC to UC; UC to inverse |
| * C | Column Overflow | | auto-<CR> at column's end |
| * R | Reset the SSC | | reset SSC + PR#0 and IN#0 |
| Z | Zap <CTRL> | | ignore all <CTRL> commands |
| F_<E/D> | Find Keyboard | E or D | accept keyboard entries |
| L_<E/D> | Generate <LF> Out | E or D | send <LF> out after <CR> |
| M_<E/D> | Mask <LF> In | E or D | drop <LF> in after <CR> |
| * T_<E/D> | Tab in BASIC | E or D | recognize BASIC tabs |
| X_<E/D> | XOFF Recognition | E or D | detect XOFF; await XON |

* Not supported by Pascal.

Table 2-4. Printer Mode Commands

# COMMANDS THAT CHANGE SWITCH SETTINGS

The group of commands discussed in this section either directly override the SSC switch settings, or affect related behavior of the SSC. The Reset command restores the switch selections.

## Baud Rate–⟨n⟩B

This command overrides the physical settings of switches SW1-1 through SW1-4 on the SSC. For example, to change the baud rate to 135 baud, type in <CTRL-I>4B<RETURN>.

| <n>= | SSC Baud Rate | <n>= | SSC Baud Rate |
|---|---|---|---|
| 0 | use SW1-1 to SW1-4 | 8 | 1200 |
| 1 | 50 | 9 | 1800 |
| 2 | 75 | 10 | 2400 |
| 3 | 109.92 (110) | 11 | 3600 |
| 4 | 134.58 (135) | 12 | 4800 |
| 5 | 150 | 13 | 7200 |
| 6 | 300 | 14 | 9600 |
| 7 | 600 | 15 | 19200 |

Table 2-5. Baud Rate Selections

## Data Format–⟨n⟩D

With this command you can override the settings of switch SW2-1. The table below shows how many data and stop bits correspond to each value of <n>. For example, <CTRL-I>2D<RETURN> causes the SSC to transmit each character in the form: one start bit (always transmitted), six data bits, and one stop bit.

| <n>= | Data Bits | Stop Bits |
|---|---|---|
| 0 | 8 | 1 |
| 1 | 7 | 1 |
| 2 | 6 | 1 |
| 3 | 5 | 1 |
| 4 | 8 | 2 (1 with Parity options 4 through 7) |
| 5 | 7 | 2 |
| 6 | 6 | 2 |
| 7 | 5 | 2 (1-1/2 with Parity options 0 through 3) |

Table 2-6. Data Format Selections

## Parity–⟨n⟩P

You can use this command to determine the kind of parity the SSC is to generate when sending data and check for when receiving data. In general, parity checking is not needed in Printer Mode. However, there are five parity options available (Table 2-4).

| <n>= | Parity to Use |
|---|---|
| 0, 2, 4 or 6 | none (default value) |
| 1 | odd parity (odd total number of ones) |
| 3 | even parity (even total number of ones) |
| 5 | MARK parity (parity bit always 1) |
| 7 | SPACE parity (parity bit always 0) |

Table 2-7. Parity Selections

For example, type <CTRL-I>1P<RETURN> to cause the SSC to transmit and check for odd parity. Odd parity means that the high bit of every character is 0 if there is already an odd number of 1 bits in that character, or 1 if there is otherwise an even number of 1 bits in the character, making the total always odd. This is an easy (but not foolproof) way to check data for transmission errors. Parity errors are recorded in a status byte (Appendix F).

## Set Time Delay–<n>C, <n>L, <n>F

Some printers are slow and do not provide a "printer busy" or handshake signal to the Apple II. The <n>C command causes the Apple II to delay a specified amount of time, after sending a carriage return character, before sending another group (usually another line) to it. This gives the print head enough time to return to the left side of the page so it is ready to continue printing.

The <n>C command overrides the setting of switch SW2-2 on the SSC. That switch provides only two choices: no delay or a 250 millisecond delay.

The <n>L command allows time after a linefeed character for a printer platen to turn so the paper is vertically positioned to receive the next line.

The <n>F command allows time after a form feed character for the printer platen to move the paper form to the top of the next page (typically a longer time than a linefeed).

| <n>= | Time Delay |
|---|---|
| 0 | none |
| 1 | 32 milliseconds |
| 2 | 250 milliseconds (1/4 second) |
| 3 | 2 seconds |

Table 2-8. Time Delay Selections

Consult the user manual for the printer to find out how much time it takes to move its print head and platen, and so to determine an appropriate set of values for these three delays. The idea is to have at least enough time for the printer parts to move the required distance, but not so much time that overall printing speed is slowed down drastically. A typical set for a VERY slow printer would be <CTRL-I>2C<RETURN>, <CTRL-I>2L<RETURN>,<CTRL-I>3F<RETURN>; that is, the SSC waits 250 milliseconds after transmitting carriage returns, 250 milliseconds after transmitting linefeeds, and 2 seconds after transmitting form feed characters.

## Generate ⟨CR⟩ On Column Overflow-C

Typing <CTRL-I>C<RETURN> causes the SSC to generate a carriage return character automatically any time the column count exceeds the printer line width.

Once this is on, only clearing the high-order bit at location $578+s (where s is the slot the SSC is in) can turn this option back off. This option is normally off.

## Generate ⟨LF⟩ Out-L_⟨E/D⟩

You can use this command to have the SSC automatically generate and transmit a linefeed character after each carriage return character. This overides the setting of switch SW2-5. For example, you can type <CTRL-I>L E<RETURN> to cause your printer to print listings or double-spaced manuscripts for editing.

## Mask (Suppress) ⟨LF⟩ In-M_⟨E/D⟩

If you type <CTRL-I>M E<RETURN>, the SSC will suppress any incoming linefeed character that immediately follows a carriage return character.

## Reset the SSC-R

Typing <CTRL-I>R<RETURN> has the same effect as sending a PR#0 and an IN#0 to a BASIC program and then resetting the SSC. This keyboard command cancels all previous commands to the SSC and puts the physical switch settings back into force.

# OTHER COMMANDS

The commands described here affect the handling of characters and tabs. The Translate command determines how characters will appear on the video screen. The Z and F commands prevent the SSC from responding to control characters or ALL characters coming from the keyboard, respectively. The X command causes the SSC to respond to the XON/XOFF software protocol. Finally, the T command implements the tabbing feature of BASIC.

## Translate Lowercase Characters–⟨n⟩T

The Apple II Monitor "translates" all incoming lowercase characters into uppercase ones before sending them to the video screen or to a BASIC program. The SSC offers four translation options:

| <n>= | What to Do with Lowercase Characters |
|---|---|
| 0 | Change all lowercase characters to uppercase ones before passing them to a BASIC program or to the video screen. This is the way the Apple II monitor handles lowercase. |
| 1 | Pass along all lowercase characters unchanged. The appearance of the lowercase characters on the Apple II screen is undefined (garbage). |
| 2 | Display lowercase characters as uppercase inverse characters (that is, as black characters on a white background). |
| 3 | Pass lowercase characters to programs unchanged, but display lowercase as uppercase, and uppercase as inverse uppercase (that is, as black characters on a white background). |

Table 2-9. Lowercase Character Displays

## Zap (Suppress) Control Characters–Z

Typing <CTRL-I>Z<RETURN> prevents the SSC from recognizing any further control characters (and hence commands) whether coming from the keyboard or contained in a stream of characters moving through the SSC.

If you issue the Z command described here, all further commands are ignored; this is useful if the data you are transmitting contains bit patterns that the SSC can mistake for control characters.

The only way to reinstate command recognition after the Z command is to reinitialize the SSC, or clear the high-order bit at location $5F8+s (where s is the slot in which the SSC is installed).

## Find Keyboard–F_⟨E/D⟩

You can protect incoming data from disruption by keystrokes with this command. For example, you can include an F D command in a program, followed by a routine that retrieves data coming in through the SSC, followed by F E later in the program. Default is F E.

## XOFF Recognition–X_⟨E/D⟩

Typing <CTRL-I>X E<RETURN> causes the SSC to look for any XOFF (decimal 19; Appendix D) character coming from a device attached to the SSC, and to respond to it by halting transmission of characters until the SSC receives an XON (decimal 17; Appendix D) from the device, signalling the SSC to continue transmission. In Printer Mode, the default value of this command is X D.

In Printer Mode, full duplex communication may not work with XOFF recognition turned on, so be careful.

## Tab in BASIC–T_⟨E/D⟩

If you type in <CTRL-I>T E<RETURN>, the BASIC horizontal position counter is left equal to the column count. All TABs work, including back-tabs. TABs beyond column 40 require a POKE to location 36, as usual. Commas only work as far as column 40, and BASIC programs will be listed in 40-column format.

# CHAPTER 3

# COMMUNICATIONS MODE

This chapter explains how to prepare, install and use the SSC in Communications Mode, and change the SSC's activities via commands.

## PREPARING THE SSC FOR COMMUNICATIONS MODE

The SSC is ready to operate in Communications Mode when the jumper block and switches SW1-5 and SW1-6 are correctly positioned.

If the triangle on the jumper block is pointing up toward the word MODEM, remove the block (using an IC Extractor, if necessary) and reinsert it with the triangle pointing toward MODEM (Figure 3-1).

Using a pointed object, set switches SW1-5 and SW1-6 both ON as shown in Figure 3-1. This puts the SSC in Communications Mode.

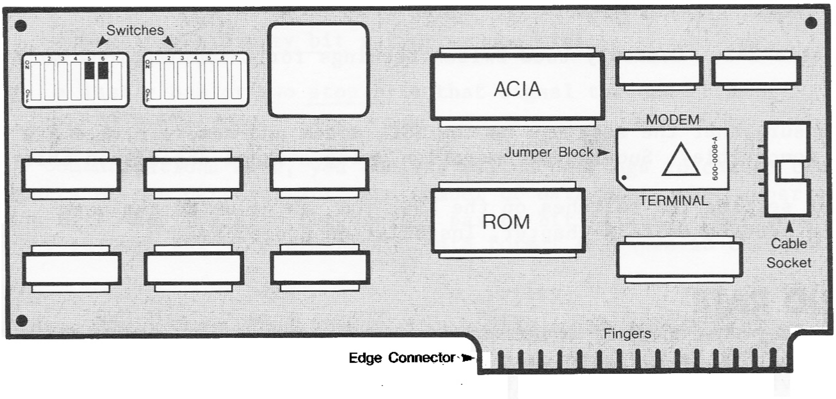

Switches
ON
OFF
1 2 3 4 5 6 7
ACIA
MODEM
Jumper Block
600-0008-A
TERMINAL
ROM
Cable Socket
Fingers
Edge Connector

Figure 3-1. SSC Set for Communications Mode

# SETTING THE SWITCHES

Use the tip of a ballpoint pen or some other sharp object to flip the appropriate tiny switches on the SSC. A switch is ON when the top of the switch rocker is pushed in. The following subsections explain what settings to use.

## COMMONLY USED SETTINGS

Table 3-1 lists the switch settings you can use for connection to various devices and services via the SSC and a modem.

| Application | Switch Settings, Cable Connections, Other Information |
|---|---|
| Apple II<br>via modem | SW1: ON OFF OFF ON ON ON ON SW2: ON ON * * OFF OFF OFF<br>Comm Mode, 300 baud, 8 data, 1 stop, * * parity<br>If using SSC in each Apple, set both the same; for local connection, second jumper block points toward TERMINAL. |
| Apple III<br>via modem | SW1: ON OFF OFF ON ON ON ON SW2: ON ON * * OFF OFF OFF<br>Comm Mode, 300 baud, 8 data, 1 stop, * * parity<br>Set Apple III RS-232-C Device Control Block to same values (See Apple III Standard Device Drivers manual). |
| Printer<br>via modem | SW1: ON OFF OFF ON ON ON ON SW2: ON OFF * * OFF OFF OFF<br>Comm Mode, 300 baud, 7 data, 1 stop, * * parity<br>Baud rate is limited by modem and transmission lines; some modems can also use 1200 baud; SW1-7 is always ON, and SW2-7 is always OFF; SCTS hookup is at remote modem. |
| Dow Jones<br>News and<br>Quotes<br>Reporter | SW1: ON OFF OFF ON ON ON ON SW2: ON OFF - ON OFF OFF OFF<br>Comm Mode, 300 baud, 7 data, 1 stop, no parity<br>Sample program at end of this chapter sets same traits.<br>Use T command for Terminal Mode operation. |

Table 3-1. Commonly Used Switch Settings for Communications Mode

Make sure that the settings on the SSC, modem and remote device are all compatible. Successful operation using a modem depends on this.

After setting the switches on the SSC, you can go on to the next major section of this chapter, Installation Procedure.

## BAUD RATE

No matter what kind of modem and remote device you connect to the SSC, the SSC is going to pass information between the Apple II and the device at a certain prearranged speed, called the baud rate. Since the Apple II can usually send and receive information faster than what is connected to it, the simplest way to determine the maximum baud rate you can use is to consult the user manual for the modem and remote device you will connect. Find out what rate is the fastest they both can handle. Once you know this, you are ready to set the baud rate switches on the SSC. The following table shows the correct switch positions.

| Baud | SW1-1 | SW1-2 | SW1-3 | SW1-4 | Baud | SW1-1 | SW1-2 | SW1-3 | SW1-4 |
|---|---|---|---|---|---|---|---|---|---|
| 50 | ON | ON | ON | OFF | 1200 | OFF | ON | ON | ON |
| 75 | ON | ON | OFF | ON | 1800 | OFF | ON | ON | OFF |
| 110* | ON | ON | OFF | OFF | 2400 | OFF | ON | OFF | ON |
| 135** | ON | OFF | ON | ON | 3600 | OFF | ON | OFF | OFF |
| 150 | ON | OFF | ON | OFF | 4800 | OFF | OFF | ON | ON |
| 300 | ON | OFF | OFF | ON | 7200 | OFF | OFF | ON | OFF |
| 600 | ON | OFF | OFF | OFF | 9600 | OFF | OFF | OFF | ON |
| (* 109.92) | | (** 134.58) | | | 19200 | OFF | OFF | OFF | OFF |

Table 3-2. Baud Rate Switch Settings

If you are connecting a printer or terminal at the other end of the modem, make sure that it is set (with its own switches, dials or thumb wheels) to the SAME baud rate! If you don't, the SSC will send and receive unrecognizable garbage.

## DATA FORMAT AND PARITY

The SSC sends each character (such as a "7" or an "H" or a "?") as a string of zeroes and ones (bits). The way it can send a character in Communications Mode, using switch settings, is this:

- first a single start bit to signal to the printer or terminal that a character is coming;
- then a string of 7 or 8 data bits representing the character;
- possibly a parity bit for error checking;
- lastly one or two stop bits that signal the end of a character.

For Communications Mode, you can use switch settings to change three aspects of the data format: the number of data bits, the number of stop bits, and the kind (if any) of parity bit to send. Switches SW2-1 through SW2-4 determine the data format as shown in this table.

| Stop Bits | SW2-1 | Data Bits | SW2-2 | Parity Bits | SW2-3 | SW2-4 |
|---|---|---|---|---|---|---|
| 1 | ON | 8 | ON | none | -- | ON |
| 2 | OFF | 7 | OFF | odd | ON | OFF |
| | | | | even | OFF | OFF |

Table 3-3. Data Format Selections

If SW2-1 is OFF, the number of stop bits will be 1 instead of 2 if both 8 data bits (SW2-2 ON) and a parity bit (SW2-4 OFF) have been selected.

To determine the correct combination of switch settings, consult the literature describing the device or timesharing service you plan to connect to the SSC in this mode.

The most commonly used format for ASCII data is: 7 data bits, 1 stop bit, and no parity bit (SW2-1 and SW2-4 ON; SW2-2 OFF).

If you set the data rate switches to 50, 75 or 110 baud, choose a switch combination that specifies 2 stop bits; for all data rates 135 baud or higher, use 1 stop bit (switch SW2-1 ON), unless device or timesharing service literature specifies otherwise.

To set the SSC for a data format different from those shown in this table, or to change the data format temporarily, use the SSC commands described later in this chapter.

## GENERATE ⟨LF⟩ OUT

If the remote device (for example, a faraway printer) does not automatically generate linefeeds after carriage returns, and it desperately needs them, then set switch SW2-5 ON. Otherwise set SW2-5 OFF.

In Communications Mode, the SSC automatically discards incoming linefeeds that immediately follow carriage returns, unless you use the M D command as described later in this chapter.

## SPECIAL SWITCHES

Switch SW2-6 controls forwarding of interrupts to the Apple II. Since the Apple II and II+ do not handle interrupts, set SW2-6 OFF.

For Communications Mode, set SW1-7 ON and SW2-7 OFF.

Your Super Serial Card is now ready to install and use in Communications Mode.

# INSTALLATION PROCEDURE

This section explains how to install the SSC and its internal cable in the Apple II. If the cable clamp is not already assembled, do so now, following the instructions given in Chapter 1.

Before connecting or disconnecting anything on the Apple, turn off the power with the switch at the back left corner of the Apple case. THIS IS ABSOLUTELY NECESSARY. If you try to connect or disconnect anything from the inside of your Apple when the power is on, you are likely to damage the circuits.

Do not unplug the Apple, just turn it off. If you unplug the Apple, you will isolate it from earth ground and leave it vulnerable to static discharges.

Remove the Apple cover by pulling up on the two back corners of the cover until the two corner fasteners pop apart. Slide the cover back until it is free of the case and then lift the cover off.

Look inside the Apple and locate the power supply case--the rectangular metal box along the left inside the Apple II. To avoid damaging the SSC, touch the power supply case with one hand; this discharges any static charge that may be on your clothes or body.

Along the back inside edge of the Apple you will see eight long narrow slots called connector slots. The connector slots are numbered from 0 at the left to 7 at the right. The numbers are printed along the back edge behind the connector slots. For use with Pascal and a modem, install the SSC in slot #2. For use with BASIC, install the SSC in any slot from #1 through #7.

Handle the Super Serial Card as you would handle an expensive phonograph record. Grasp it only by the corners or edges, and do not touch the components or pins, especially the gold fingers on the edge connector.

There are three deep notches along the back of the Apple II case. Temporarily set the SSC down near the desired slot. Then take the clamp assembly and slide it down into the notch closest to the slot that the SSC will be in. Tighten the screws until the connector assembly can no longer be moved in the opening.

Grasp the upper corners of the SSC and insert the gold fingers of the edge connector into the slot in the back of the Apple, rear edge first. Gently push the front edge of the card down until it is level and firmly seated. Figure 3-2 shows how the SSC looks when installed in slot #2.

Note that the outer ends of the screws in the clamp assembly can act as nuts. They are threaded and can receive screws from the printer or terminal connector, to ensure a good connection with the Apple.

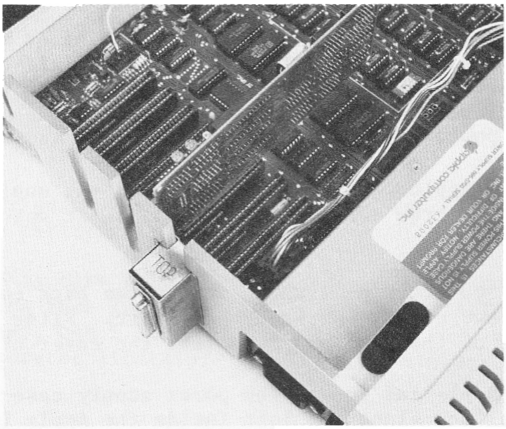


Figure 3-2. SSC in Slot #2 and Clamp Assembly in Notch

Slide the Apple case top plate in place and press down on the rear corners until the corner fasteners pop into place. The Super Serial Card is now installed.

## EXTERNAL CABLE AND CONNECTOR

The SSC cable connector you installed in the notch is a standard DB-25 connector with 25 pins. Ten pins of the connector are connected internally to the SSC.

You will need a cable to connect the modem or other device to the SSC connector on the Apple II. Cables with 25-pin connectors on one end are available from your Apple dealer.

The cable must have internal shielding, with the shielding properly terminated at both ends, to prevent electromagnetic interference to nearby radios, television sets, and communication equipment. This shielding is necessary for the system to comply with Class B Federal Communications Commission limits as defined by Subpart J of Part 15 of the FCC rules. Unshielded cables are not recommended.

✋ Make sure that all devices are connected to the same grounded AC power circuit (three-wire wall outlet) as the Apple II. Connecting ungrounded equipment to your Apple II can cause severe electrical damage.

# USING SSC IN COMMUNICATIONS MODE

Communications Mode allows you to use the SSC with a modem, connected to a remote device (such as a remote printer, terminal, or other computer). After installing the SSC, you can control its operation from a BASIC, Pascal or assembly-language program, or even directly from the keyboard. To use the SSC in Communications Mode, do the following:

- Make sure the jumper block points toward MODEM.
- Under BASIC or DOS, boot the Apple II, and then type in PR#s and IN#s to route input and output, respectively, to and from the remote device. (The SSC is in slot s.)
- Under Pascal, boot the Apple II and then use #7: or REMIN: for input, and #8: or REMOUT: for output. (The SSC is in slot #2.)
- If the modem and remote device don't work, refer to Appendix E for troubleshooting hints, or consult your Apple dealer.

# COMMUNICATIONS MODE COMMANDS

You can issue any of the commands described in this section by embedding them in a computer program. Under BASIC or DOS, you can also enter them directly at the Apple (or remote terminal) keyboard.

In a BASIC program, put the control character and command in a PRINT statement. In a Pascal program, embed the command in a WRITE or WRITELN statement.

Before keyboard entry of these commands has any effect on the SSC, you must first issue an IN#s command (with the SSC in slot s). When you then enter the command character (usually <CTRL-A>, see below), the prompt APPLE SSC: appears on the display screen. Subsequent characters up to <RETURN> will be interpreted as an SSC command. Pressing the left arrow key before pressing <RETURN> cancels the command and causes the APPLE SSC: prompt to reappear.

Many of these commands override the physical switch settings on the SSC. This makes it unnecessary to open the Apple II case and manually change the SSC switch settings. To change the values back to the physical switch settings, reboot or reset the Apple II, or type in the Reset command described below.

## COMMAND FORMATS

All commands are preceded by the Communications Mode command character (usually <CTRL-A>, see below) and followed by <RETURN>. The notation <CTRL-A> means "hold down the CTRL key while pressing A." There are three types of command formats:

- a number <n> followed by an uppercase letter (for example, 4D to set Data Format 4)
- simply an uppercase letter (for example, R to Reset the SSC)
- an uppercase letter followed by a space and then either E to Enable or D to Disable a feature (for example, L D to Disable automatic generation of linefeed characters)

The allowable range of <n> is given in each command description below. The choice of Enable or Disable is written as <E/D>.

The underscore character (_) before the <E/D> in Enable/Disable commands is merely a reminder that a space is required there.

The SSC checks only numbers and the first letters of commands and options. All such letters must be uppercase. Further letters, which you can add to assist your memory, have no effect on the SSC. For example, E(cho E(nable is the same as E E. The SSC ignores invalid commands.

## THE COMMAND CHARACTER

The normal command character in Communications Mode is <CTRL-A>. You can send the command character itself through the SSC by typing it twice in a row: <CTRL-A><CTRL-A> (no <RETURN> necessary). This special command allows you to transmit the command character without affecting the operation of the SSC, and without having to change to another command character and then back again later.

If you want to change the command character from <CTRL-A> to <CTRL-something else>--for example, <CTRL-W>--type <CTRL-A><CTRL-W>. To change back, type <CTRL-W><CTRL-A>. No <RETURN> is required after either of these commands.

Do not change the control character to <CTRL-S>, <CTRL-T> or <CTRL-R>, since in Communications Mode the SSC interprets these as special control commands from a remote device.

The command character <CTRL-A> is ASCII code 1. Here is how to generate this character in BASIC and Pascal:

```
Integer BASIC:     PRINT "*command"  *embedded <CTRL-A>
Applesoft BASIC:   PRINT CHR$(2): "command"
Pascal:            WRITELN (CHR(2),'command');
```

## COMMUNICATIONS MODE COMMAND SUMMARY

Table 3-4 is a summary of the commands available in Communications Mode. Some details, explained fully in the remainder of this chapter, have been omitted from the table for the sake of brevity. Commands marked with an asterisk are not supported by Pascal.

| Format | Command Name | Values | Interpretation |
|---|---|---|---|
| <n>B | Baud Rate | 0 - 15 | see Table 3-5 |
| <n>C | <CR> Delay | 0 | no delay |
| | | 1 | 32 milliseconds |
| | | 2 | 250 milliseconds (1/4 s) |
| | | 3 | 2 seconds |
| <n>D | Data Format | 0 | 8 data bits, 1 stop bit |
| | | 1 | 7 data bits, 1 stop bit |
| | | 2 | 6 data bits, 1 stop bit |
| | | 3 | 5 data bits, 1 stop bit |
| | | 4 | 8 data bits, 2 stop bits |
| | | 5 | 7 data bits, 2 stop bits |
| | | 6 | 6 data bits, 2 stop bits |
| | | 7 | 5 data bits, 2 stop bits |
| <n>F | <FF> Delay | 0 | no delay (default) |
| | | 1 | 32 milliseconds |
| | | 2 | 250 milliseconds (1/4 s) |
| | | 3 | 2 seconds |
| <n>L | <LF> Delay | 0 | no delay (default) |
| | | 1 | 32 milliseconds |
| | | 2 | 250 milliseconds (1/4 s) |
| | | 3 | 2 seconds |
| <n>P | Parity | 0,2,4,6 | no parity (default = 0P) |
| | | 1 | odd parity |
| | | 3 | even parity |
| | | 5 | MARK (parity bit always 1) |
| | | 7 | SPACE (parity bit always 0) |
| * <n>S | Screen Slot | 0-7 | chain SSC output to slot n |
| * <n>T | Translate Lowercase (LC) | 0 | change all LC to UC |
| | | 1 | leave LC (possible garbage) |
| | | 2 | LC to UC inverse; leave UC |
| | | 3 | LC to UC; UC to inverse |
| B | Break | | transmit 233 ms BREAK |
| * R | Reset the SSC | | SW reset + PR#0 and IN#0 |
| * T | Terminal Mode | | (see Terminal Mode section) |
| Z | Zap <CTRL> | | ignore all <CTRL> commands |
| * E_<E/D> | Echo | E or D | echo input on the screen |
| F_<E/D> | Find Keyboard | E or D | accept keyboard entries |
| L_<E/D> | Generate <LF> Out | E or D | send <LF> out after <CR> |
| M_<E/D> | Mask <LF> In | E or D | drop <LF> in after <CR> |
| X_<E/D> | XOFF Recognition | E or D | detect XOFF; await XON |

* Not supported by Pascal.

Table 3-4. Summary of Communications Mode Commands

# COMMANDS THAT CHANGE SWITCH SETTINGS

The commands discussed in this section either override the SSC switch settings, or affect related behavior of the SSC. The Reset command restores the switch selections.

## Baud Rate–<n>B

This command overrides the physical settings of switches SW1-1 to SW1-4 on the SSC. For example, to change the rate to 9600 baud, type <CTRL-A>14B<RETURN>.

| <n>= | SSC Baud Rate | <n>= | SSC Baud Rate |
|---|---|---|---|
| 0 | use SW1-1 to SW1-4 | 8 | 1200 |
| 1 | 50 | 9 | 1800 |
| 2 | 75 | 10 | 2400 |
| 3 | 109.92 (110) | 11 | 3600 |
| 4 | 134.58 (135) | 12 | 4800 |
| 5 | 150 | 13 | 7200 |
| 6 | 300 | 14 | 9600 |
| 7 | 600 | 15 | 19200 |

Table 3-5. Baud Rate Selections

## Data Format–<n>D

With this command you can override the settings of switches SW2-1 and SW2-2. The table below shows how many data and stop bits correspond to each value of <n>. For example, typing <CTRL-A>3D <RETURN> causes the SSC to transmit each character in the form: one start bit (always transmitted), five data bits, and one stop bit.

| <n>= | Data Bits | Stop Bits |
|---|---|---|
| 0 | 8 | 1 |
| 1 | 7 | 1 |
| 2 | 6 | 1 |
| 3 | 5 | 1 |
| 4 | 8 | 2 (1 with <n>P options 4 through 7) |
| 5 | 7 | 2 |
| 6 | 6 | 2 |
| 7 | 5 | 2 (1-1/2 with <n>P options 0 through 3) |

Table 3-6. Data Format Selections

## Parity–<n>P

You can use this command to determine the kind of parity the SSC is to generate when sending data and check for when receiving data. There are five parity options available:

| <n>= | Parity to Use |
|---|---|
| 0, 2, 4 or 6 | none |
| 1 | odd parity (odd number of 1's) |
| 3 | even parity (even number of 1's) |
| 5 | MARK parity (parity bit always 1) |
| 7 | SPACE parity (parity bit always 0) |

Table 3-7. Parity Selections

For example, type <CTRL-A>1P<RETURN> to cause the SSC to transmit and check for odd parity. Odd parity means that the high bit of every character is 0 if there is already an odd number of 1 bits in that character, or 1 if there is otherwise an even number of 1 bits, making the total always odd. This is an easy (but not foolproof) way to check data for transmission errors. (See Appendix F.)

## Generate ⟨LF⟩ Out-L_⟨E/D⟩

You can use this command to have the SSC automatically generate and transmit a linefeed (<LF>) character after each carriage return (<CR>) character. This overides the setting of switch SW2-5. For example, you can type <CTRL-A>L E<RETURN> to cause your printer to produce double-spaced listings or manuscripts for editing.

## Mask (Suppress) ⟨LF⟩ In-M_⟨E/D⟩

If you type <CTRL-A>M D<RETURN>, the SSC will not remove incoming linefeed (<LF>) characters that immediately follow carriage return (<CR>) characters.

## Reset the SSC-R

Typing <CTRL-A>R<RETURN> has the same effect as sending a PR#0 and an IN#0 to a BASIC program and then resetting the SSC. This keyboard command cancels all previous commands to the SSC and puts the physical switch settings back into force.

## OTHER COMMANDS

The commands described in this subsection control the handling of characters and of the video screen. Three commands control timed delays following transmission of <CR>, <LF> and <FF> characters. The Translate command controls the display of lowercase and uppercase characters. The Z and F commands suppress control characters and characters entered at the keyboard, respectively. The X command causes the SSC to check the character stream for XOFF, as part of the XON/XOFF protocol. Finally, the <n>S command routes video output to a selected slot, and the E command suppresses display (echo) of characters on the screen.

## Set Time Delays–⟨n⟩C, ⟨n⟩L, ⟨n⟩F

Some printers are slow and do not provide a "printer busy" or handshake signal to the Apple II. If such a printer is connected to the SSC via a modem, you may want to use these three delay commands.

The <n>C command causes the Apple II to delay a specified amount of time, after sending a carriage return character, before sending another group (usually another line) to it. This gives the print head enough time to return to the left side of the page so it is ready to continue printing.

The <n>L command allows time after a linefeed character for a printer platen to turn so the paper is vertically positioned to receive the next line.

The <n>F command allows time after a form feed character for the printer platen to move the paper form to the top of the next page (typically a longer time than a Linefeed).

| <n>= | Time Delay |
|---|---|
| 0 | none |
| 1 | 32 milliseconds |
| 2 | 250 milliseconds (1/4 second) |
| 3 | 2 seconds |

Table 3-8. Time Delay Selections

Consult the user manual for the printer to find out how much time it takes to move its print head and platen, and so to determine an appropriate set of values for these three delays if a printer is used as the remote device. The idea is to have at least enough time for the printer parts to move the required distance, but not so much time that overall printing speed is slowed down drastically.

## Translate Lowercase Characters–⟨n⟩T

The Apple II monitor "translates" all incoming lowercase characters into uppercase ones before sending them to the video screen or to a BASIC program. With the <n>T command, four options are available:

| <n>= | What to Do with Lowercase Characters |
|---|---|
| 0 | Change all lowercase characters to uppercase before passing them to a BASIC program or to the video screen. This is what the Apple II monitor does to lowercase. |
| 1 | Pass along all lowercase characters unchanged. The appearance of the lowercase characters on the Apple II screen is undefined (garbage). |
| 2 | Display lowercase characters as uppercase inverse characters (that is, as black characters on a white background). |
| 3 | Pass lowercase characters to programs unchanged, but display lowercase as uppercase, and uppercase as inverse uppercase (that is, as black characters on a white background). |

Table 3-9. Lowercase Character Displays

## Zap (Suppress) Control Characters–Z

Typing <CTRL-A>Z<RETURN> prevents the SSC from recognizing any further control characters (and hence commands) in the stream of characters moving through the SSC.

If you issue the Z command, all further commands are ignored; this is useful if the data you are transmitting contains bit patterns that the SSC can mistake for control characters.

The only way to reinstate command recognition after invoking the Z command is to reset the SSC, or clear the high-order bit at location $5F8+s (with the SSC in slot s).

## Find Keyboard–F_⟨E/D⟩

You can protect incoming data from disruption by keystrokes with this command. For example, you can include <CTRL-A>F D in a program, followed by a routine that retrieves data coming in through the SSC, followed by <CTRL-A>F E later in the program.

## XOFF Recognition–X_⟨E/D⟩

In Communications Mode, the SSC automatically recognizes any XOFF (decimal 19; Appendix D) character coming from a device attached to it, and responds to it by halting transmission of characters. The SSC resumes transmission as soon as it receives an XON character (decimal 17; Appendix D) from the device. To disable XOFF recognition, use <CTRL-A>X D<RETURN>.

## Specify Screen Slot-⟨n⟩S

With this command you can specify the slot number of the device where you want text or listings displayed. (Normally this is slot #0, the Apple II video screen.) This allows "chaining" of the SSC to another card slot, such as an 80-column-display peripheral card. For the firmware in the SSC to pass on information to the firmware in the other card, the other card must have an output entry point within its Cs00 space; this is the case for all currently available 80-column-display cards for the Apple II.

For example, let's say you have the SSC in slot #2 with a remote terminal connected to it, and an 80-column-display card in slot #3. Type <CTRL-A>3S<RETURN> to cause the data from the remote terminal to be chained through the card in slot #3, so that it is displayed on the Apple II in 80-column format. (Not available in Pascal.)

## Echo Characters on the Screen-E_⟨E/D⟩

For the Apple II, as for most computers, displaying (echoing) a character on the video screen is a separate step from receiving it from the keyboard, though we tend to think if these as one step, as on a typewriter. For example, if you type in <CTRL-A>E D<RETURN>, the SSC does not forward incoming characters to the Apple II screen. This can be used to hide someone's password entered at a terminal, or to avoid double-display of characters.

# TERMINAL MODE

Under Communication Mode, the SSC can enter Terminal Mode and make the Apple II act like an unintelligent terminal. This is useful for connecting the Apple II to a computer timesharing service, or for conversing with another Apple II.

Terminal Mode makes it possible to generate lowercase characters, plus the ten ASCII characters not provided on the Apple II keyboard (plus ESC, since <ESC> is used for this feature).

To generate lowercase characters, press <ESC> (the "ESCAPE" key near the upper left corner of the Apple II keyboard) once, and then type alphabetic characters as you would normally do. After that, to capitalize a single letter, press <ESC> again before typing the letter. To lock the keyboard in uppercase, press <ESC> twice in succession. To get back to lowercase, press <ESC> once, as before.

To generate one of the special ASCII characters listed in Table 3-10, first press <ESC> once (if necessary) to place the keyboard in lowercase mode. Then press <ESC> a second time, followed by one of the top-row keys as shown in Table 3-10. For example, to send a tilde, make sure the keyboard is in lowercase mode, then type <ESC> followed by 9.

| <ESC> followed by: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | : |
|---|---|---|---|---|---|---|---|---|---|---|---|
| generates: | FS | US | [ | \ | _ | { | \| | } | ~ | ESC | RUB |
| or in hexadecimal: | 9C | 9F | DB | DC | DF | FB | FC | FD | FE | 9B | FF |

Table 3-10. Special ASCII Character Generation

# TERMINAL MODE COMMANDS

The commands that specifically affect Terminal Mode are listed in Table 3-11. The Translate, Echo and XOFF commands are described earlier in this chapter.

| Format | Command Name | Interpretation |
|---|---|---|
| T | Enter Terminal Mode | Go into Terminal Mode. |
| B | Transmit a Break Signal | Send a 233-millisecond BREAK (signoff) signal. |
| * E_<E/D> | Echo Enable/Disable | Default E D (full-duplex); use E E for half-duplex. |
| S_<E/D> | Special Characters Enable/Disable | Default S E; allows/defeats generation of lowercase and special characters (Table 3-10). |
| * <n>T | Translate Lowercase Characters | Determine treatment of incoming lowercase characters. |
| * X_<E/D> | XOFF Recognition Enable/Disable | Default X E; in Terminal Mode, X E makes SSC detect <CTRL-R> and <CTRL-T> (remote-control OFF & ON, respectively), but not <CTRL-S>. |
| Q | Quit (Exit from) Terminal Mode | Return to normal Communications Mode operation. |

* Fully described earlier in this chapter.

Table 3-11. Terminal Mode Commands

## Enter Terminal Mode–T

This causes the Apple II to function as a full-duplex unintelligent terminal. You can use this command in conjunction with the ECHO command to simulate the half-duplex terminal mode of the old Apple II Communications Card. Type <CTRL-A>T<RETURN> to enter this mode.

If you enter Terminal Mode and don't see what you type echoed on the Apple video screen, probably the modem link has not yet been established, or you need to use the E(cho E(nable command.

## Transmit a Break Signal–B

Typing <CTRL-A>B<RETURN> causes the SSC to transmit a 233-millisecond break signal, recognized by most time-sharing systems as a signoff.

## Special Characters–S_⟨E/D⟩

Typing <CTRL-A>S E<RETURN> causes the SSC to interpret <ESC><n> pairs as special characters, allowing a keyboard in this way to generate all possible ASCII characters. If you type <CTRL-A>S D<RETURN>, the SSC will treat the <ESC> key like any other key.

## Quit (Exit from) Terminal Mode–Q

Type <CTRL-A>Q<RETURN> to exit from terminal mode.

# A TERMINAL MODE EXAMPLE

You can use the sample program below to change the SSC temporarily from the characteristics you ordinarily use, to the characteristics needed to make the Apple II into a dumb terminal connected to the Dow Jones News & Quotes Reporter. This program assumes that the SSC is set for Communications Mode and that the jumper block is pointing toward MODEM. Neither of these conditions can be changed by software. This program also assumes that the SSC is in slot #1 and that you want to chain I/O to an 80-column card in slot #3; these conditions you can change via software. To change this Integer BASIC program to an Applesoft program, substitute CHR$(5) for D$ and CHR$(2) for A$, and leave out program lines 40 and 42.

```
 10 REM ******************************************************
 20 REM *    THIS PROGRAM SETS UP THE SSC FOR DOW JONES      *
 30 REM ******************************************************
 40 D$="": REM  TYPE <CTRL-D> ESCAPE CHARACTER BETWEEN QUOTES
 42 A$="": REM  TYPE <CTRL-A> COMMAND CHARACTER BETWEEN QUOTES
 50 PRINT D$;"PR#1":        REM  SSC IS IN SLOT #1;
 52 PRINT A$;"6 BAUD":      REM  SET BAUD RATE TO 300;
 54 PRINT A$;"1 DATA":      REM  DATA FORMAT OF 7 DATA, 1 STOP
 56 PRINT A$;"0 PARITY":    REM  AND NO PARITY;
 58 PRINT A$;"LF DISABLE":  REM  NO <LF> GENERATION AFTER <CR>.
 60 PRINT A$;"3 SLOTCHN":   REM  CHAIN TO CARD IN SLOT #3
 62 PRINT A$;"TERM MODE":   REM  AND ENTER TERMINAL MODE.
 70 REM ******************************************************
 72 REM * NOW YOU SHOULD BE IN TERMINAL MODE, GETTING THE    *
 74 REM * INFO YOU NEED FROM THE DOW JONES SERVICE.  WHEN    *
 76 REM * FINISHED, EXIT WITH THE <CTRL-A>Q(UIT COMMAND.     *
 78 REM ******************************************************
100 REM  Q(UIT COMMAND SENDS CONTROL BACK TO THIS PROGRAM:
110 PRINT A$;"RESET":       REM  RESET SWITCH-SELECTED OPTIONS
120 END
```

## CHAPTER 4

# HOW THE SCC WORKS

This chapter is divided into three major sections. The first explains what the SSC does, using everyday terms wherever possible. Those of you already familiar with serial data communication can skip this section.

The second section is for anyone who wants an overview of the SSC's operating modes and configuration possibilities.

The third section is a dyed-in-the-wool hardware theory of operation for both the expert and the adventuresome layperson.

## SERIAL DATA COMMUNICATION

The SSC is a device that performs serial data communication. Let's consider communication first, then data, and then serial data and data transfer.

Communication is easy enough: getting information from here to there or from there to here. In this discussion, the Apple II is "here." "There" can be nearby (local) or far enough away (remote) that some intermediate device, like a telephone, is needed. Information moving from here to there (out of the Apple) is called output; information moving from there to here (into the Apple) is called input.

Data denotes information in its many forms. For successful data communication, it is essential that both the sender and receiver agree on their interpretation of the data transferred.

Inside the Apple II, data can be numbers and letters and symbols, or program instructions for the computer to carry out, or pointers to storage locations, or error message numbers, or codes for generating pictures or sounds (or lots of other things).

In the Apple II, as in all other computers, data is represented in codes made up of ones and zeros, the only two digits allowed in the binary (two-element) system. Each one or zero is called a BInary digiT or bit. In the binary system, as in our ordinary decimal system, you can count to as high a number as you want--it just takes more digits to get there than in the decimal system--and use each number as a code to represent that number of different items. Table 4-1 gives some examples of how many items you can represent with various quantities of digits.

| System | Digits | Using | You can represent |
|---|---|---|---|
| decimal | 0 - 9 | 1 | ten items (0 through 9) |
| | | 2 | one hundred (0 through 99) |
| | | 3 | one thousand (0 through 999) |
| binary | 0 and 1 | 1 | two items (0 or 1) |
| | | 2 | four (0, 1, 10 or 11) |
| | | 3 | eight (0 through 111) |
| | | 4 | sixteen (0 through 1111) |
| | | 5 | thirty-two (0 through 11111) |
| | | 6 | sixty-four (0 through 111111) |
| | | 7 | one hundred twenty-eight |
| | | 8 | two hundred fifty-six, etc. |

Table 4-1. Binary and Decimal Digits and Quantities

For printers, plotters, terminals, and many other devices, 128 codes are enough to distinguish all the necessary characters: 52 for the upper and lowercase alphabet, 10 for the decimal digits, and dozens of others for punctuation marks and special symbols. As a result, the 128-character American Standard Code for Information Interchange (ASCII) is widely used. (This 7-bit code is listed in Appendix D.)

Throughout the world, post, telegraph, telex and wire services use 5-bit and 6-bit code sets, even though so few bits cannot represent a very large selection of items. Meanwhile, computers have a penchant for sending each other streams of 8-bit codes with obscure meanings. As long as sender and receiver agree on interpretation, any set of codes will do. The SSC can send all of them.

## PARALLEL DATA IN THE APPLE II

The Apple II is called an eight-bit processor because the basic unit of data it uses and moves around internally is an eight-bit byte. The Apple II has sets of eight lines interconnecting its various internal parts, so it can move around all eight bits at the same time. Since the bits travel together like eight cars side by side on an eight-lane highway, data in the Apple II is called parallel data, and data movements within the Apple II are called parallel data transfers (Figure 4-1).

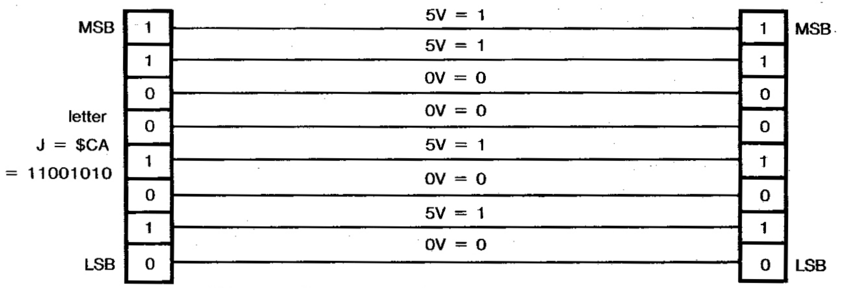

MSB
letter
J = $CA
= 11001010
LSB
5V = 1
5V = 1
0V = 0
0V = 0
5V = 1
0V = 0
5V = 1
0V = 0
1
1
0
0
1
0
1
0
MSB
LSB

Figure 4-1. Parallel Data Transfer

## SERIAL DATA FOR LONG DISTANCES

Just as it would be extremely costly to build highways with eight lanes in each direction over great distances, so it is costly to connect two widely separated pieces of equipment using eight lines in each direction. So, many manufacturers produce computers, printers, plotters, terminals and so forth that send and receive information along one line in each direction, one bit after another. Such a setup, with bits moving from one place to another like a string of cars in a single lane, is called a serial data transfer (Figure 4-2).

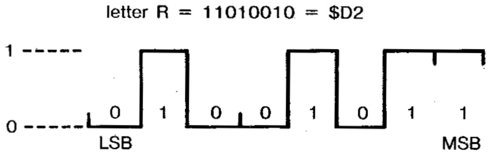

letter R = 11010010 = $D2
1
0
0
1
0
0
1
0
1
1
LSB
MSB

Figure 4-2. Serial Data Transfer

## DATA CONVERSION

Changing parallel data to serial data or vice versa is called data conversion (Figure 4-3). By convention (see the later subsection describing RS-232-C), whenever parallel data is converted to serial data, the right-hand bit is sent first. It is as though there were a traffic law that when a multi-lane highway narrows to a single lane, the car in the right lane goes first, then the car from the left lane to the left, etc.

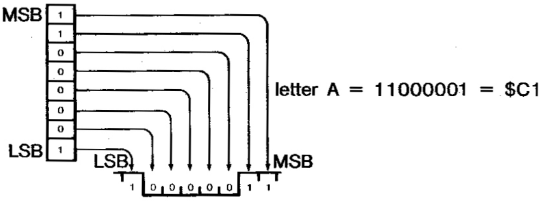

MSB
1
1
0
0
0
0
0
1
LSB
letter A = 11000001 = $C1
LSB
MSB
1
0
0
0
0
0
1
1

Figure 4-3. Parallel-to-Serial Data Conversion

# RS-232-C DATA FORMATS

Serial data communication became popular so quickly that a group of manufacturers and the telephone company formed the Electronic Industries Association (EIA) to agree upon standard ways of sending and receiving data. What has become the most widely used standard in the world is called Revision C of standard RS-232, or RS-232-C. The SSC sends and receives data in accordance with this standard. The serial data has the form shown in Figure 4-3, plus a start bit at the beginning, an optional parity bit after the five to eight data bits, and finally one or two stop bits at the end (Figure 4-4). This is the data format that most RS-232-C devices use.

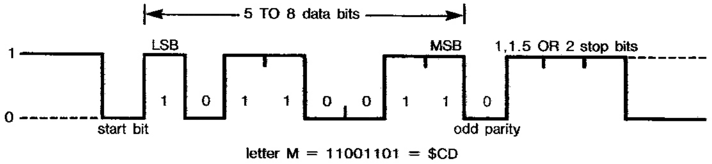


Figure 4-4. RS-232-C Serial Data Format

What is this mysterious parity bit all about? It is an optional extra bit set to 0 or 1 to make the total number of data and stop bits set to 1 an odd number (odd parity) or an even number (even parity); or this extra bit can always be set to 0 (called SPACE parity) or to 1 (MARK parity).

The combined total of data and parity bits set to 1 in Figure 4-4 is 5, an odd number (and the parity bit is 1), so it qualifies as a correct character if odd parity (or MARK parity) has been agreed upon by sender and receiver. However, if that same character were received under even parity (or SPACE parity), the receiving device would signal that a transmission error had occurred. If one bit in a character changes during transmission, parity checking will detect the error. If two bits change, the error will go undetected.

# RS-232-C SIGNALS

Since the RS-232-C standard stems from the early days of telephone and telegraph, the names given to its signals may sound quaint to our "modern" ears. However, the signals correspond to familiar conditions that we take for granted when using a telephone. Table 4-2 lists the basic signals required by the RS-232-C standard, and what conditions they correspond to in a telephone call that you originate. Think of yourself as the Data Terminal (a terminus or end point of the conversation), and the phone as the Data Set (the communication device). Note: not is indicated by a bar above a signal name.

| RS-232-C Signal | Abbrev. | Similar to |
|---|---|---|
| Data Terminal Ready | DTR | you pick up the phone |
| Data Set Ready | DSR | the phone is working |
| Request To Send | RTS | you want to talk |
| Clear To Send | CTS | the phone has established a connection and the person at the other end is ready to listen |
| Transmit Data | TxD | you speak into the phone |
| not Request To Send | $\overline{\text{RTS}}$ | you've finished talking and are ready to listen or to hang up |
| not Clear To Send | $\overline{\text{CTS}}$ | the phone has sent your words and is ready for your next request to send a message |
| not Data Terminal Rdy | $\overline{\text{DTR}}$ | you hang up |

Table 4-2. RS-232-C Signals As Interpreted by the Sender

Here are the RS-232-C signals and how you would interpret them if you were to answer a telephone call (Table 4-3).

| RS-232-C Signal | Abbrev. | Similar to |
|---|---|---|
| Ring Indicator | RI | the phone rings (optional) |
| Data Set Ready | DSR | you pick up the phone; it works |
| Data Carrier Detect | DCD | you hear background noise |
| Receive Data | RxD | you hear what is said |
| not Data Set Ready | $\overline{\text{DSR}}$ | the other party has hung up |

Table 4-3. RS-232-C Signals As Interpreted by the Receiver

## Modems

All of the above signals refer to the interaction between what RS-232-C calls Data Terminal Equipment (DTE--end points of data transfers, such as the Apple II or a printer) and what it calls Data Communication Equipment (DCE--transmitting or receiving devices, such as modems).

What is a modem? The name is short for MOdulator/DEModulator. As a modulator it takes electrical signals from a computer or printer (or other device) that it is connected to, and turns them into musical tones over a telephone line. As a demodulator it takes the musical tones it detects on a telephone line and turns them back into electrical signals for use by the printer or computer (or other device) that it is connected to. It also handles the RS-232-C control signals to and from that device (Figure 4-5).

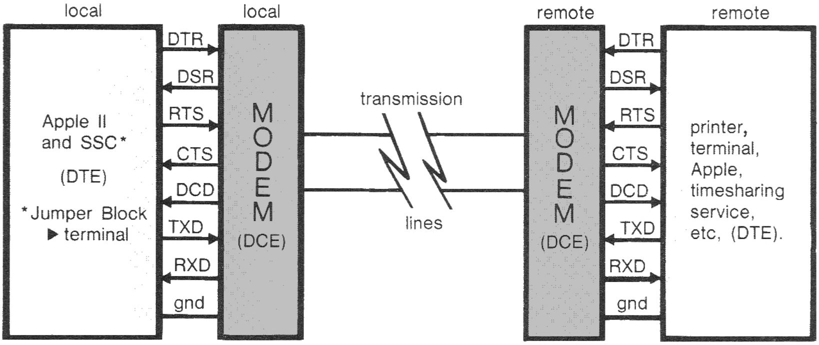

local
local
remote
remote
Apple II
and SSC*
(DTE)
*Jumper Block
▶ terminal
DTR
DSR
RTS
CTS
DCD
TXD
RXD
gnd
MODEM
(DCE)
transmission
lines
MODEM
(DCE)
DTR
DSR
RTS
CTS
DCD
TXD
RXD
gnd
printer,
terminal,
Apple,
timesharing
service,
etc, (DTE).

Figure 4-5. An RS-232-C Setup with Modems

By convention, the calling (originate) modem produces a fairly high tone (let's say LA) as the background or carrier signal that it sends; it then modulates (changes) that tone to SO to mean 0 and TI to mean 1. Meanwhile, the called (answer) modem plays a lower tone, MI, as a carrier signal, and modulates that tone to RE to indicate 0 or FA to indicate 1. In this way, both modems can send and receive information along the same wires without interpreting what they send as received messages and vice versa. (All their voices sound alike.)

## Modem Eliminators

RS-232 signals are designed for the interactions of two DTE's, two DCE's, and telephone lines, as shown in Figure 4-5. What if you just want to connect two DTE's together in the same room, directly (for example, an Apple II and a printer)? You can use what is called a null modem or modem eliminator. The jumper block on the SSC does just that when it is connected with its triangle pointing toward the word TERMINAL.

By using different tones to send and receive information, modems can make sure that what comes from the "mouthpiece" (transmit register) of one DTE gets routed to the "earpiece" (receive register) of the other. A null modem simply crosses those two wires (Figure 4-6).

To simulate the other signal exchanges that modems would perform, the null modem interconnects the signal wires as shown in Figure 4-6. Thus RTS gets turned back to the sender as CTS as though the phone had instantly established a connection; RTS is also connected to DCD on the other side to pretend that a carrier signal has been detected. Finally, connecting DTR (willing to transfer data) from one side to both RI and DSR (a call arriving) on the other side completes the simulated telephone connection. (RI is optional.) The jumper block does it all!

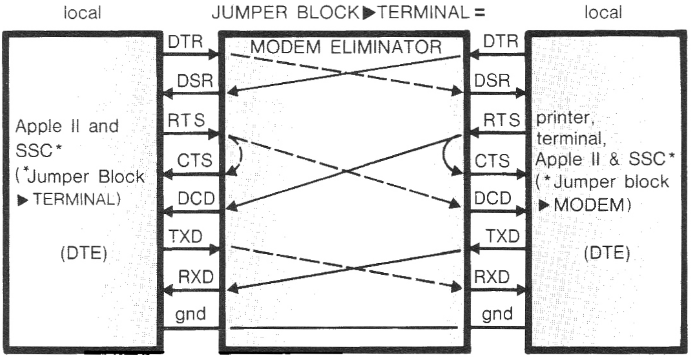

local
JUMPER BLOCK▶TERMINAL =
local
MODEM ELIMINATOR
Apple II and SSC* (*Jumper Block ▶TERMINAL)
(DTE)
DTR
DSR
RTS
CTS
DCD
TXD
RXD
gnd
printer, terminal, Apple II & SSC* (*Jumper block ▶MODEM)
(DTE)

Figure 4-6. An RS-232-C Setup with a Modem Eliminator

# SSC MODES AND CONFIGURATIONS

Figure 4-7 outlines the possible operating modes of the Super Serial Card and their relationships to each other.

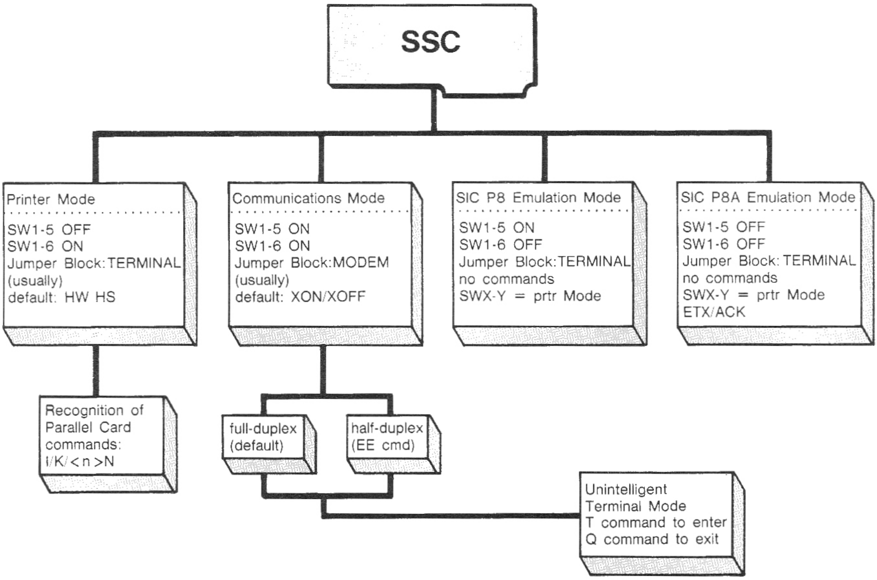

SSC
Printer Mode
SW1-5 OFF
SW1-6 ON
Jumper Block: TERMINAL (usually)
default: HW HS
Communications Mode
SW1-5 ON
SW1-6 ON
Jumper Block: MODEM (usually)
default: XON/XOFF
SIC P8 Emulation Mode
SW1-5 ON
SW1-6 OFF
Jumper Block: TERMINAL
no commands
SWX-Y = prtr Mode
SIC P8A Emulation Mode
SW1-5 OFF
SW1-6 OFF
Jumper Block: TERMINAL
no commands
SWX-Y = prtr Mode
ETX/ACK
Recognition of Parallel Card commands: I/K/<n>N
full-duplex (default)
half-duplex (EE cmd)
Unintelligent Terminal Mode
T command to enter
Q command to exit

Figure 4-7. SSC Operating Modes

Figure 4-8 illustrates the chief configurations possible with the Super Serial Card and how to set them up.

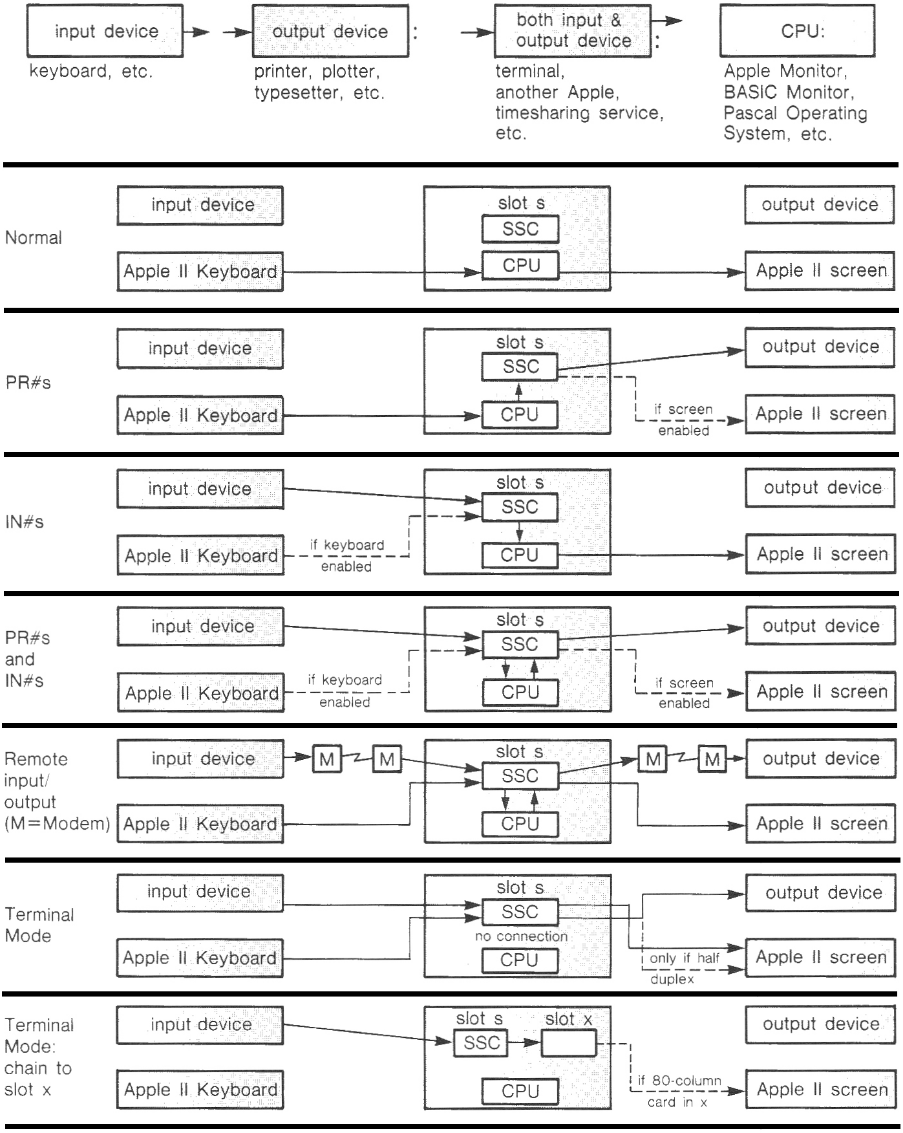

input device
keyboard, etc.
output device:
printer, plotter, typesetter, etc.
both input & output device:
terminal, another Apple, timesharing service, etc.
CPU:
Apple Monitor, BASIC Monitor, Pascal Operating System, etc.
Normal
PR#s
IN#s
PR#s and IN#s
Remote input/output (M=Modem)
Terminal Mode
Terminal Mode: chain to slot x
input device
Apple II Keyboard
slot s
SSC
CPU
M
output device
Apple II screen
if screen enabled
if keyboard enabled
no connection
only if half duplex
slot x
if 80-column card in x

Figure 4-8. SSC Configurations

# THEORY OF OPERATION

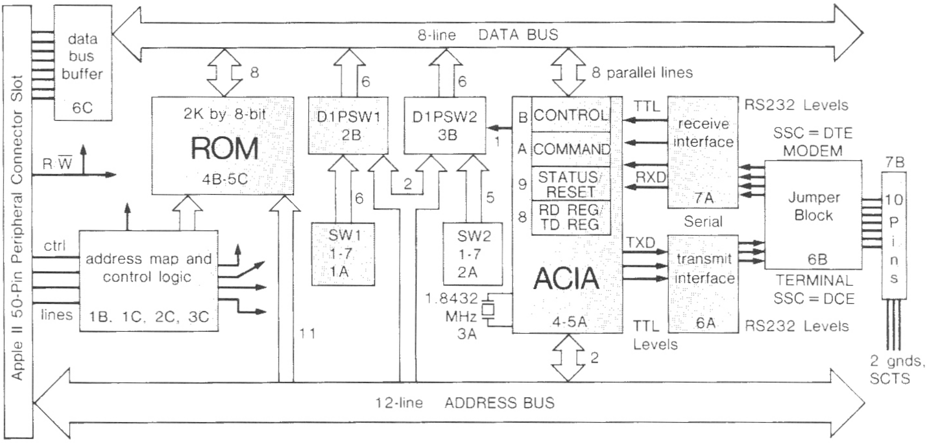
This section explains the SSC's overall theory of operation, but not the internal workings of each IC chip. If you would like such information, it is best to obtain specifications from the IC manufacturers. The most complex component is the ACIA, which is a Synertek 6551 or equivalent.

While reading through this section, you may find it useful to refer to Figure 4-9, a block diagram of the SSC, or to the schematic diagram in Appendix C. All references in the form 1A, 3C, etc., pertain to coordinates on the printed circuit board itself. Here is an inventory of the main components of the SSC:

- 50-pin connection to the Apple II peripheral connector slot
- a 12-line address bus
- addressing and control logic (1B, 1C, 2C, 3C)
- a 2K-by-8-bit ROM (4B-5C)
- jumpers and bow ties for optional substitution of RAM (3-4A)
- two blocks of 7 switches each (1A, 2A)
- two registers for reading the switch settings (2B, 3B)
- an Asynchronous Communications Interface Adapter (ACIA; 4-5A) with its internal registers:

| | |
|---|---|
| status/reset register | control register |
| transmit/receive data register | command register |

- a 1.8432 MHz oscillator (3A) for the ACIA
- a transmit interface (6A) and a receive interface (7A)
- an 8-line data bus
- a buffer for the data bus (6C)
- a jumper block (6B) that can function as a modem eliminator
- a 10-pin header (7B) to connect the SSC to a DB-25 jack via a short internal cable (discussed in Appendix C)



Apple II 50-Pin Peripheral Connector Slot
data bus buffer
6C
8-line DATA BUS
8
6
6
8 parallel lines
2K by 8-bit
ROM
4B-5C
D1PSW1
2B
D1PSW2
3B
1
B CONTROL
A COMMAND
9 STATUS/RESET
8 RD REG/TD REG
TTL
receive interface
7A
RXD
RS232 Levels
SSC = DTE
MODEM
7B
R/W
2
6
5
Jumper Block
6B
10 Pins
Serial
ctrl
lines
address map and control logic
1B, 1C, 2C, 3C
SW1
1-7
1A
SW2
1-7
2A
TXD
transmit interface
6A
TERMINAL
SSC = DCE
ACIA
4-5A
1.8432 MHz
3A
11
TTL Levels
RS232 Levels
2
2 gnds, SCTS
12-line ADDRESS BUS

Figure 4-9. Overall Block Diagram of the SSC

## ADDRESSING AND CONTROL LOGIC

The twelve address lines (A0 - A11) from the Apple II provide all the necessary $C000 addressing on the SSC. Control logic at 1B, 1C, 2C and 3C, plus the signals RESET, DEVICE SELECT, I/O SELECT, and I/O STROBE, ensure the routing of signals to the appropriate addresses.

The SSC follows the Apple II protocol in its use of the $C800 address space. An LS279 (1B) serves as a NAND gate, a pair of inverters, and a set-reset latch. The latch is set by an access to the $Csxx space, and is reset by access to the $CFxx space or by a reset. When this set-reset latch is set, the Apple II can access the $C800 space on the SSC. A small RC filter prevents the latch from being reset by spurious noise.

### ROM/RAM Space

The 2K ROM (4B-5C) containing the SSC driver firmware resides in the $C800 - $CFFF address space. However, an LS00 (2C) and an LS32 (3C) remap the addresses from the range $Cs00 - $CsFF to the range $CF00 - $CFFF, since the $CFxx addresses are unusable. (Access to them disables use of the $C800 address space.) As a result of this remapping, only one ROM is required, and none of the ROM space is wasted.

The SSC can use a 2K-by-8-bit RAM in place of the ROM. Between columns 3 and 4 and rows A and B on the SSC, there are three jumper pads and three bow ties. If you solder the jumper pads and cut the bow ties, pins 18, 20 and 21 will be, respectively, chip enable, output enable and read-write control (instead of ROM enables).

The ROM (or RAM) addresses are mapped as follows (Table 4-4). The first 256-byte block is the Peripheral Card ROM Space, selected when I/O SELECT from the Apple II drops to 0 volts. The remaining seven blocks are in the I/O Expansion ROM Space, selected when I/O STROBE from the Apple II drops to 0 volts.

| SSC ROM/RAM Addresses | Become Apple II Addresses |
|---|---|
| $0700 - $07FF | $Cs00 - $CsFF |
| $0000 - $00FF | $C800 - $C8FF |
| $0100 - $01FF | $C900 - $C9FF |
| $0200 - $02FF | $CA00 - $CAFF |
| $0300 - $03FF | $CB00 - $CBFF |
| $0400 - $04FF | $CC00 - $CCFF |
| $0500 - $05FF | $CD00 - $CDFF |
| $0600 - $06FF | $CE00 - $CEFF |

Table 4-4. SSC Address Remapping

## Registers in Peripheral I/O Space

Whenever DEVICE SELECT drops to 0 volts, the Apple II is addressing the SSC's Peripheral I/O Space (the sixteen bytes starting at $C080 + s0). This signal is combined logically with address lines A0 through A3 to select one of the six registers that reside in that space (Table 4-5).

| Chip selected | Address(+s0) | Purpose of register |
|---|---|---|
| LS365 (2B) | $C081 | store state of SW1 (1A) (read) |
| LS365 (3B) | $C082 | store state of SW2 (2A) and state of CTS (read) |
| ACIA (4-5A) | $C088 | receive (read), transmit (write) |
| ACIA (4-5A) | $C089 | status (read), reset (write) |
| ACIA (4-5A) | $C08A | command (read and write) |
| ACIA (4-5A) | $C08B | control (read and write) |

Table 4-5. Registers in SSC Peripheral I/O Space

The two LS365 chips act as buffers so that the state of eleven of the fourteen available switches, plus the state of RS-232-C signal Clear To Send (CTS), can be read. There are 3.3K ohm pullup resistors at the switch inputs of the LS365 chips. A closed switch pulls down an input, and it is read as zero.

Three switches are not connected to the LS365s. Switch SW2-6, when ON, passes interrupt requests from the ACIA to the Apple II. (The Apple II, however, currently does not support interrupts.) Setting switches SW1-7 ON and SW2-7 OFF connects DB-25 pin 8 (DCD) to the DCD input of the ACIA. Setting SW1-7 OFF and SW2-7 ON splices pin 19, Secondary Clear To Send (SCTS), onto the DCD input of the ACIA when the jumper block is in the TERMINAL position.

The ACIA has two pins used to select one of its four registers. While address lines A2 and A3 select the chip, A0 and A1 select the actual register. The SSC firmware reads and writes ACIA register contents; these registers are discussed in detail in Appendix A.

## THE ACIA

The Asynchronous Communications Interface Adapter (ACIA) is the central and most complex element of the SSC. It and the crystal at 3A form a 1.8432 MHz oscillator. The ACIA divides this frequency down to one of the fifteen baud rates it supports. The ACIA also handles all incoming and outgoing primary RS-232-C signals. The ACIA registers (discussed fully in Appendix A) control hardware handshaking and select the baud rate, data format and parity. Finally, the ACIA performs parallel/serial and serial/parallel data conversion, and single-buffers data transfers.

## DATA INPUT AND OUTPUT

The MC1489 at 7A converts the incoming serial data from RS-232-C to TTL voltage levels. The MC1488 at 6A converts the outgoing serial data from TTL to RS-232-C voltage levels, and in conjunction with three capacitors limits the output slew rate. Three of the received handshake lines (Clear To Send, Data Carrier Detect, and Data Set Ready) have 15K ohm pullup resistors so the SSC will work with devices that do not assert those signals.

## DATA BUS

The 8-bit data bus on the SSC is, of course, a parallel bus. The ACIA takes output from it and gives input to it in parallel form. Also connected to the bus are the two switch detection registers (2B and 3B) and the ROM or RAM chip.

An LS245 (6C) buffers the output to the data bus, and minimizes input loading. The data bus has a 3.3K ohm pullup resistor on each line so the data inputs on the LS245 are not floating when it turns on in output mode.

## JUMPER BLOCK

The jumper block has two positions: when its arrow points toward MODEM, the SSC looks like Data Terminal Equipment (DTE); that is, the SSC is prepared to talk to Data Communication Equipment (DCE), such as a modem. When installed with its arrow pointing toward TERMINAL, the jumper block acts as a modem eliminator (null modem); that is, the SSC looks like the DCE on the other device's side of a serial communication connection. In this position, the SSC can talk directly to a printer or any other DTE. Figure 4-6 shows the signal swapping that the jumper block in the TERMINAL position performs.

# APPENDIX A
# FIRMWARE

This appendix contains the following information:

- an explanation of the Pascal 1.1 firmware card protocol
- a firmware memory map
- a description of the SSC's use of its peripheral slot scratchpad RAM addresses
- a description of the ACIA registers and switch detection registers in the SSC's peripheral I/O space
- a list of firmware entry points a [illegible]gister values
- the actual SSC firmware listings

## PASCAL 1.1 FIRMWARE PROTOCOL

The old Apple II Serial Interface Card (SIC) ran under Pascal 1.0 with three direct firmware entry points, one for each of the three I/O functions it supported:

| Address | Contains |
|---|---|
| $C800 | initialization routine entry point |
| $C84D | read routine entry point |
| $C9AA | write routine entry point |

New peripheral cards can be "accepted" into the Pascal 1.0 system by appearing to be a SIC; that is, with these same three entry points and with $38 at $Cs05 and $18 at $Cs07 (see Device ID section below).

Pascal 1.1, on the other hand, has a more flexible setup, and also supports more I/O functions. It can make indirect calls to the firmware in a (new) peripheral card through addresses in a branch table in the card's firmware. It also has facilities for uniquely identifying new peripheral I/O devices.

# I/O ROUTINE ENTRY POINTS

The I/O routine entry point branch table is located near the beginning of the Cs00 address space (s being the slot number where the peripheral card is installed). This space was chosen instead of the $C800 space, since under BASIC protocol the $Cs00 space is required, while the $C800 space is optional.

The branch table locations that Pascal 1.1 uses are:

| Address | Contains |
|---|---|
| $Cs0D | initialization routine offset (required) |
| $Cs0E | read routine offset (required) |
| #Cs0F | write routine offset (required) |
| $Cs10 | status routine offset (required) |
| $Cs11 | $00 if optional offsets follow; non-zero if not |
| $Cs12 | control routine offset (optional) |
| $Cs13 | interrupt handling routine offset (optional) |

Notice that $Cs11 contains $00 only if the control and interrupt handling routines are supported by the firmware. (For example, the SSC does not support these two routines, and so location $Cs11 contains a (non-zero) firmware instruction.) Apple II Pascal 1.0 and 1.1 do not support control and interrupt requests, but such requests may be implemented in future versions of the Pascal BIOS and other future Apple II operating systems.

Here are the entry point addresses, and the contents of the 6502 registers on entry to and on exit from Pascal 1.1 I/O routines:

| Addr. | Offset for | X Register | Y Register | A Register |
|---|---|---|---|---|
| $Cs0D | Initialization | | | |
| | On entry | $Cs | $s0 | |
| | On exit | error code | (unchanged) | (unchanged) |
| $Cs0E | Read | | | |
| | On entry | $Cs | $s0 | |
| | On exit | error code | (unchanged) | character read |
| $Cs0F | Write | | | |
| | On entry | $Cs | $s0 | char. to write |
| | On exit | error code | (unchanged) | (unchanged) |
| $Cs10 | Status | | | |
| | On entry | $Cs | $s0 | request (0 or 1) |
| | On exit | error code | (changed) | (unchanged) |

Notes: Request code 0 means, "Are you ready to accept output?"
Request code 1 means, "Do you have input ready?"
On exit, the reply to the status request is in the carry bit: carry clear means "No"; carry set means "Yes."

Table A-1. I/O Routine Offsets and Registers under Pascal 1.1

## DEVICE IDENTIFICATION

Pascal 1.1 uses four firmware bytes to identify the peripheral card. Both the identifying bytes and the branch table are near the beginning of the $Cs00 ROM space. The identifiers are listed in Table A-2.

| Address | Value |
|---|---|
| $Cs05 | $38 (like the old Serial Interface Card) |
| $Cs07 | $18 (like the old Serial Interface Card) |
| $Cs0B | $01 (the Generic Signature of new FW cards) |
| $Cs0C | $ci (the Device Signature; see below) |

Table A-2. Bytes Used for Device Identification

The first digit, c, of the Device Signature byte identifies the device class as listed in Table A-3.

| Digit | Class |
|---|---|
| $0 | reserved |
| $1 | printer |
| $2 | joystick or other X-Y input device |
| $3 | serial or parallel I/O card |
| $4 | modem |
| $5 | sound or speech device |
| $6 | clock |
| $7 | mass storage device |
| $8 | 80-column card |
| $9 | network or bus interface |
| $A | special purpose (none of the above) |
| $B-F | reserved for future expansion |

Table A-3. Device Class Digit

The second digit, i, of the Device Signature byte is a unique identifier for the card, assigned by Apple Technical Support. For example, the SSC has a Device Signature of $31: the 3 signifies that it is a serial or parallel I/O card, and the 1 is the low-order digit supplied by Apple Technical Support.

Although version 1.1 of Pascal ignores the Device Signature, applications programs can use them to identify specific devices.

# SSC FIRMWARE MEMORY USAGE

Table A-4 is an overall map of the locations that the SSC uses, both in the Apple II and in the SSC's own firmware address space.

| Addresses | Name of area | Contents |
|---|---|---|
| $0000-$00FF | Page Zero | Monitor pointers, I/O hooks, and temporary storage (Table A-5) |
| $04xx-$07xx (selected locations) | Peripheral Slot Scratchpad RAM | Locations (8 per slot) in Apple's pages $04 through $07. SSC uses all eight of them (Table A-6) |
| $C0(8+s)0 - $C0(8+s)F | Peripheral Card I/O Space | Locations (16 per slot) for general I/O; SSC uses 6 bytes (Table A-7) |
| $Cs00-$CsFF | Peripheral Card ROM Space | One 256-byte page reserved for card in slot s; first page of SSC FW |
| $C800-$CFFF | Expansion ROM | Eight 256-byte pages reserved for a 2K ROM or PROM; SSC maps its FW onto $C800-$CEFF (Table 4-4) |

Table A-4. Memory Usage Map

## ZERO PAGE LOCATIONS

The SSC makes use of these zero-page locations (Table A-5):

| Address | Name | Description |
|---|---|---|
| * $24 | CH | Monitor pointer to current position of cursor on screen |
| $26 | SLOT16 | Usually (slot# x 16); that is, $s0 |
| $27 | CHARACTER | Input or output character |
| * $28 | BASL | Monitor pointer to current screen line |
| $2A | ZPTMP1 | Temporary storage (various uses) |
| $2B | ZPTMP2 | Temporary storage (various uses) |
| $35 | ZPTEMP | Temporary storage (various uses) |
| * $36 | CSWL | BASIC output hook (not for Pascal) |
| * $37 | CSWH | (high byte of CSW) |
| * $38 | KSWL | BASIC input hook (not for Pascal) |
| * $39 | KSWH | (high byte of KSW) |
| * $4E | RNDL | random number location, updated when looking for a keypress (not used when initialized by Pascal) |

* Not used when Pascal initializes SSC.

Table A-5. Zero-Page Locations Used by SSC

# SCRATCHPAD RAM LOCATIONS

The SSC uses the Scratchpad RAM locations as listed in Table A-6.

| Address | Field name | Bit(s) | Interpretation |
|---|---|---|---|
| $0478+s | DELAYFLG | 0 - 1 | <FF> delay selection |
| | | 2 - 3 | <LF> delay selection |
| | | 4 - 5 | <CR> delay selection |
| | | 6 - 7 | Translate option |
| $04F8+s | HANDSHKE | 0 - 7 | Buffer count for handshake (P8A Mode) |
| | PARAMETER | 0 - 7 | Accumulator for FW's command processor |
| $0578+s | STATEFLG | 0 - 2 | Command mode when not 0 (Printer and Communications Modes only) |
| | | 0 - 4 | Enquire character (P8A Mode); dflt ETX |
| | | 3 - 5 | Slot to chain to (Communications Mode) |
| | | 6 | Set to 1 after lowercase input character |
| | | 7 | Terminal Mode when 1 (Comm Mode) |
| | | 7 | Enable <CR> gen. when 1 (other 3 modes) |
| $05F8+s | CMDBYTE | 0 - 6 | Printer Mode default is <CTRL-I>; Comm Mode default is <CTRL-A> |
| | | 7 | Set to 1 to Zap control commands |
| $0678+s | STSBYTE | | Status and IORESULT byte (Appendix F) |
| $06F8+s | CHNBYTE | 0 - 2 | Current Apple screen slot (Comm Mode); when slot = 0, chaining is enabled |
| | | 3 - 7 | $Cs00 space entry point (Comm Mode) |
| | PWDBYTE | 0 - 7 | Current printer width (other modes); for listing compensation, auto-<CR> |
| $0778+s | BUFBYTE | 0 - 6 | One-byte input buffer (Comm Mode); used in conjunction with XOFF recognition |
| | | 7 | Set to 1 when buffer full (Comm Mode) |
| | COLBYTE | 0 - 7 | Current-column counter for tabbing, etc. (other 3 modes) |
| $07F8+s | MISCFLG | 0 | Generate <LF> after <CR> when 1 |
| | | 1 | Printer Mode when 0; Comm Mode when 1 |
| | | 2 | Keyboard input enabled when 1 |
| | | 3 | <CTRL-S> (XOFF), <CTRL-R> and <CTRL-T> input checking when 1 |
| | | 4 | Pascal Op Sys when 1; BASIC when 0 |
| | | 5 | Discard <LF> input when 1 |
| | | 6 | Enable lowercase and special character generation when 1 (Comm Mode) |
| | | 6 | Tabbing option on when 1 (Printer Mode) |
| | | 7 | Echo output to Apple screen when 1 |

Table A-6. Scratchpad RAM Locations Used by SSC

# PERIPHERAL CARD I/O SPACE

There are 16 bytes of I/O space allocated to each slot in the Apple II. Each set begins at address $C080 + (slot x 16); for example, if the SSC is in slot 3, its group of bytes extends from $C0B0 to $C0BF. Table A-7 interprets the 6 bytes the SSC uses.

| Address | Register | Bit(s) | Interpretation |
|---|---|---|---|
| $C081+s0 | DIPSW1 | 0 | SW1-6 is OFF when 1, ON when 0 |
| | (SW1-x) | 1 | SW1-5 is OFF when 1, ON when 0 |
| | | 4 - 7 | same as above for SW1-4 through SW1-1 |
| $C082+s0 | DIPSW2 | 0 | Clear To Send (CTS) is true (-) when 0 |
| | (SW2-x) | 1 - 3 | same as above for SW2-5 through SW2-3 |
| | | 5 & 7 | same as above for SW2-2 & SW2-1 |
| $C088+s0 | TDREG | 0 - 7 | ACIA Transmit Register (write) |
| | RDREG | 0 - 7 | ACIA Receive Register (read) |
| $C089+s0 | STATUS | | ACIA Status/Reset Register |
| | | 0 | Parity error detected when 1 |
| | | 1 | Framing error detected when 1 |
| | | 2 | Overrun detected when 1 |
| | | 3 | ACIA Receive Register full when 1 |
| | | 4 | ACIA Transmit Register empty when 1 |
| | | 5 | Data Carrier Detect (DCD) true when 0 |
| | | 6 | Data Set Ready (DSR) true when 0 |
| | | 7 | Interrupt (IRQ) has occurred when 1 |
| $C08A+s0 | COMMAND | | ACIA Command Register (read/write) |
| | | 0 | Data Terminal Ready (DTR): enable (1) or disable (0) receiver and all interrupts |
| | | 1 | When 1, allow STATUS bit 3 to cause IRQ |
| | | 2 - 3 | Control transmit interrupt, Request To Send (RTS) level, and transmitter |
| | | 4 | When 0, normal mode for receiver; when 1, echo mode (but bits 2 and 3 must be 0) |
| | | 5 - 7 | Control parity (values: Table 2-7) |
| $C08B+s0 | CONTROL | | ACIA Control Register (read/write) |
| | | 0 - 3 | Baud rate: $0 = 16 times external clock; $1 - $F = decimal in Table 2-5 |
| | | 4 | When 1, use baud rate generator; when 0, use external clock (not supported) |
| | | 5 - 6 | Number of data bits: 8 (bit 5 and 6 = 0) 7 (5 = 1, 6 = 0), 6 (5 = 0, 6 = 1) or 5 (bit 5 and 6 both = 1) |
| | | 7 | Number of stop bits: 1 (bit 7 = 0); if bit 7 = 1, then 1-1/2 (with 5 data bits, no parity), 1 (8 data plus parity) or 2 |

Table A-7. SSC Registers in Peripheral Card I/O Space

# SSC ENTRY POINTS

This section contains the SSC firmware entry points for the Apple II Monitor, BASIC, Pascal 1.0 and Pascal 1.1. The Pascal 1.1 entry point offsets conform to the Firmware card protocol outlined in the first section of this appendix.

## MONITOR ROM ENTRY POINTS

The SSC uses these entry points in the Monitor ROM, unless Pascal initializes the SSC.

| Address | Name | Description |
|---|---|---|
| $FDED | COUT | sends a character to output hook (chaining)<br>used for chaining |
| $FE89 | SETKBD | sets KSW to point to keyboard (reset) |
| $FE93 | SETSCR | sets CSW to point to Apple screen (reset) |
| $FF58 | IORTS | known position of an RTS instruction |
| $FDF6 | VIDOUT | sends a character to the Apple screen |

Table A-8. Monitor ROM Entry Points Used by SSC

## BASIC ENTRY POINTS

Here are the entry point addresses, and the contents of the 6502 registers on entry to and on exit from BASIC I/O routines:

| Addr. | Routine | X Register | Y Register | A Register |
|---|---|---|---|---|
| $Cs00 | Initialization | | | |
| | On entry | anything | anything | anything |
| | On exit | (unchanged) | (unchanged) | character |
| Notes: | CSW and/or KSW points to $Cs00. The character in the A register is output unless KSW points to $Cs00 and CSW does not point to $Cs00. | | | |
| $Cs05 | Input | | | |
| | On entry | anything | anything | anything |
| | On exit | (unchanged) | (unchanged) | character in |
| Notes: | Character in is from ACIA or keyboard. | | | |
| $Cs07 | Output | | | |
| | On entry | anything | anything | character out |
| | On exit | (unchanged) | (unchanged) | (changed) |
| Notes: | Character out is transmitted through the ACIA. | | | |

Table A-9. BASIC Entry Points Used by SSC

## PASCAL 1.0 ENTRY POINTS

There are three Pascal 1.0 entry points: one for initialization, one for read operations, and one for write operations. These entry points are direct addresses.

| Addr. | Routine | X Register | Y Register | A Register |
|---|---|---|---|---|
| $C800 | Initialization | | | |
| | On entry | $Cs | $s0 | anything |
| | On exit | $Cs | $s0 | (unchanged) |
| Notes: | $C800 space is enabled. Firmware initializes SSC to default values plus SW1 and SW2 selections. | | | |
| $C84D | Read | | | |
| | On entry | $Cs | $s0 | anything |
| | On exit | $Cs | $Cs | character in |
| Notes: | $C800 space is enabled. Pascal returns ACIA or keyboard data in the A Register and location $678+s with high bit cleared. | | | |
| $C9AA | Write | | | |
| | On entry | $Cs | $s0 | character out |
| | On exit | error code | $Cs | (changed) |
| Notes: | $C800 space is enabled. Output character is transmitted through the ACIA. Pascal posts error code to IORESULT. | | | |

Table A-10. Pascal 1.0 Entry Points Used by SSC

## PASCAL 1.1 ENTRY POINTS

The Pascal 1.1 entry point protocol is outlined in the first section of this appendix. The values given here are the addresses of the routines. Unlike Pascal 1.0, Pascal 1.1 enters these routines using indirect addressing.

| Addr. | Offset for | Value | X Register | Y Register | A Register |
|---|---|---|---|---|---|
| $Cs0D | Initialization | $(Cs)8E | | | |
| | On entry | | $Cs | $s0 | anything |
| | On exit | | $00 | $s0 | (changed) |
| Notes: | $C800 space is enabled. Firmware initializes SSC to default values plus SW1 and SW2 selections. | | | | |
| $Cs0E | Read | $(Cs)94 | | | |
| | On entry | | $Cs | $s0 | anything |
| | On exit | | error code | $Cs | char. in |
| Notes: | $C800 space is enabled. Character in from ACIA or keyboard is returned in the A Register. | | | | |
| $Cs0F | Write | $(Cn)97 | | | |
| | On entry | | $Cs | $s0 | char. out |
| | On exit | | error code | $Cs | (changed) |
| Notes: | $C800 space is enabled. The byte in the A Register is sent out through the ACIA. | | | | |
| $Cs10 | Status | $(Cs)9A | | | |
| | On entry | | $Cs | $s0 | request (0 or 1) |
| | On exit | | error code | $s0 | error code |
| Notes: | $C800 space is enabled. Request = 0 asks ACIA whether it is ready to transmit another byte; request = 1 asks ACIA whether it has an input character available. On exit, carry bit = 0 for Yes or 1 for No. | | | | |

Table A-11. Pascal 1.1 Offsets Used by SSC

## OTHER SPECIAL FIRMWARE LOCATIONS

The SSC firmware uses several other addresses for predefined purposes. Table A-12 lists these locations.

| Address | Value | Purpose |
|---|---|---|
| $Cs05 | $38 | Pascal serial/firmware card identifier (as well as BASIC input entry point) |
| $Cs07 | $18 | Pascal serial/firmware card identifier (as well as BASIC output entry point) |
| $Cs0B | $01 | Pascal 1.1 generic signature byte ($01 = firmware card) |
| $Cs0C | $31 | Pascal 1.1 Device Signature byte ($31 = serial or parallel I/O card #1) |
| $Cs11 | $85 | Pascal 1.1 optional routines flag (nonzero value = not supported) |
| $CsFF | $08 | Firmware revision level |

Table A-12. SSC Special Firmware Locations

# SSC FIRMWARE LISTINGS

```
0000:        **********************************
0000:        *                                *
0000:        * APPLE II SSC FIRMWARE          *
0000:        *                                *
0000:        *    BY LARRY KENYON             *
0000:        *     -JANUARY 1981-             **************
0000:        *                                             *
0000:        * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
0000:        *                                             *
0000:        ***********************************************
0000:        *                                *
0000:        * VARIABLE DEFINITIONS           *
0000:        *                                *
0000:        **********************************
0000:        ******************
0000:        * ZERO PAGE EQUS *
0000:        ******************
0024:        CH       EQU  $24      ;CURSOR HORIZONTAL POSITION
0026:        SLOT16   EQU  $26      ;SAVE $N0 TO FREE UP Y-REG
0027:        CHARACTER EQU $27      ;OUTPUT, SCREEN AND INPUT CHARS
0028:        BASL     EQU  $28      ;BASE SCREEN ADDRESS POINTER
0035:        ZPTEMP   EQU  $35      ;WORKHORSE TEMPORARY
002A:        ZPTMP1   EQU  $2A      ;WHEN ZPTEMP ISN'T ENOUGH
002B:        ZPTMP2   EQU  $2B      ;TEMPORARIES, TEMPORARIES!
0036:        CSWL     EQU  $36      ;CHAR OUT VECTOR
0037:        CSWH     EQU  $37
0038:        KSWL     EQU  $38      ;CHAR IN VECTOR
0039:        KSWH     EQU  $39
003C:        A1L      EQU  $3C      ;BATCH MOVE POINTER
004E:        RNDL     EQU  $4E      ;RANDOM NUMBER SEED
004F:        RNDH     EQU  $4F
0000:        *******************
0000:        * GENERAL EQUATES *
0000:        *******************
0100:        STACK    EQU  $100     ;SYSTEM STACK BLOCK
0200:        INBUFF   EQU  $200     ;SYSTEM INPUT BUFFER
C000:        KBD      EQU  $C000    ;KEYBOARD INPUT
C010:        KBDSTRB  EQU  $C010    ;KEYBOARD CLEAR
CFFF:        ROMSOFF  EQU  $CFFF    ;DISABLES C0-RES. $C800 ROMS
0000:        **********************
0000:        * SSC CARD ADDRESSES *
0000:        **********************
C081:        DIPSW1   EQU  $C081    ;(+$N0) DIPSWITCH BLOCK 1
C082:        DIPSW2   EQU  $C082    ;(+$N0) DIPSWITCH BLOCK 2
C088:        TDREG    EQU  $C088    ;(+$N0) TRANSMIT DATA REG (WRITE)
C088:        RDREG    EQU  $C088    ;(+$N0) READ DATA REG (READ)
C089:        STREG    EQU  $C089    ;(+$N0) STATUS REGISTER (READ)
C089:        RESET    EQU  $C089    ;(+$N0) SOFTWARE RESET (WRITE)
C08A:        CMDREG   EQU  $C08A    ;(+$N0) COMMAND REGISTER (R/W)
C08B:        CTLREG   EQU  $C08B    ;(+$N0) CONTROL REGISTER (R/W)
```

```
0000:     ************************************************************
0000:     *  BIT-> B7  B6  B5  B4  B3  B2  B1  B0
0000:     *        +---------------------------+
0000:     * DIPSW1 S1  S2  S3  S4  Z   Z   S5  S6  (LEFT DIPSWITCH)
0000:     *
0000:     * (S1-S4 USED FOR BAUD RATE, S5-S6 FOR FIRMWARE MODE)
0000:     *
0000:     * DIPSW2 S1  Z   S2  Z   S3  S4  S5  CTS (RIGHT DIPSWITCH)
0000:     *
0000:     * STREG  INT DSR DCD TDR RDR OVR FE  PE
0000:     *
0000:     * CTLREG STB << WL >> CK << BAUD RATE >>
0000:     *
0000:     * CMDREG <<PARITY >> ECH <<XMIT>> RE DTR
0000:     *
0000:     *************************************************************
0000:     ****************************************
0000:     * SCREEN VARIABLES: PPC AND SIC MODES *
0000:     ****************************************
0538:     CMDBYTE EQU  $5F8-$C0  ;HOLDS COMMAND CHARACTER (PPC & CIC)
0438:     HANDSHKE EQU $4F8-$C0  ;SIC P8A CHAR COUNTER FOR ETX/ACK
0438:     PARAMETER EQU $4F8-$C0 ;ACCUMULATOR FOR CMD PARAMETER
04B8:     STATEFLG EQU $578-$C0  ;
0000:     * B7=CR GEN ENB FLAG  B6=AFTER LC INPUT FLG
0000:     * B2-B0=COMMAND INTERPRETER STATES
0000:     *    0 0 0  IDLE
0000:     *    0 0 1  CMD CHAR RECEIVED
0000:     *    0 1 0  COLLECT <N> UNTIL CHAR THEN DO COMMAND
0000:     *    0 1 1  SKIP UNTIL SPACE, THEN GOTO STATE 4
0000:     *    1 0 0  E/D COMMANDS
0000:     *    1 0 1  UNUSED
0000:     *    1 1 0  WAIT UNTIL CR THEN SET STATE TO ZERO
0000:     *    1 1 1  WAIT UNTIL CR THEN DO PROC INDICATED BY PARM
0000:     *
0000:     * (B4-B0 DETERMINE ENQUIRE CHAR FOR P8A MODE)
0000:     *
03B8:     DELAYFLG EQU $478-$C0
0000:     * B7-B6=SCREEN TRANSLATION OPTIONS
0000:     *  0 0   LC->UC
0000:     *  0 1   NO TRANSLATION
0000:     *  1 0   LC->UC INVERSE
0000:     *  1 1   LC->UC, UC->UC INVERSE
0000:     *  (1-3 WILL ALLOW LC CHARS TO PASS THRU MONITOR)
0000:     *
0000:     * B5-B4=CR DELAY   0 0 = NO DELAY
0000:     * B3-B2=LF DELAY   0 1 = 32 MILLISEC
0000:     * B1-B0=FF DELAY   1 0 = 1/4 SEC
0000:     *                  1 1 = 2 SEC
0000:     *
05B8:     STSBYTE EQU  $678-$C0  ;STATUS/IORESULT/INPUT BYTE
0638:     PWDBYTE EQU  $6F8-$C0  ;PRINTER (FORMAT) WIDTH
06B8:     COLBYTE EQU  $778-$C0  ;COLUMN POSITION COUNTER
0738:     MISCFLG EQU  $7F8-$C0  ;
0000:     * B7=ECHO BIT          B6=TABBING OPTION ENABLE
0000:     * B5=LINEFEED EAT      B4=PASCAL/BASIC FLAG
0000:     * B3=XOFF ENB FLAG     B2=KEYBOARD ENB
0000:     * B1=PPC/CIC MODE      B0=LF GENERATE ENB
0000:     *
```

```
0000:          112 ***************************************
0000:          113 * TEMP SCREEN VARS (SLOT INDEPENDENT) *
0000:          114 ***************************************
07F8:          115 MSLOT   EQU  $7F8      ;BUFFER FOR HI SLOT ADDR ($CN)
0000:          116 **********************************
0000:          117 * SCREEN VARIABLES: CIC MODE     *
0000:          118 **********************************
0000:          119 *
0000:          120 * STATEFLG: B7=TERMINAL MODE FLAG
0000:          121 *        B3-B5=CHAIN SLOT
0000:          122 *
0638:          123 CHNBYTE EQU  $6F8-$C0  ;CURRENT OUTPUT SCREEN ($CN00 ENTRY)
0000:          124 *
0000:          125 * B0-B7=CN00 ENTRY
0000:          126 *
06B8:          127 BUFBYTE EQU  $778-$C0  ;BUFFER FOR ONE
0000:          128 *                        INPUT BYTE: HIGH BIT IS SET
0000:          129 *                        WHEN BUFFER IS FULL
0000:          130 *
0000:          131 * MISCFLG:                B6=TERM MODE SHIFT ENB
0000:          132 *
0000:          133 * OTHER SLOT VARIABLES AS DEFINED FOR PPC AND SIC MODES
0000:          134 *
0000:          135 ***********************
0000:          136 * MONITOR SUBROUTINES *
0000:          137 ***********************
FDED:          138 COUT    EQU  $FDED     ;CHARACTER OUT (THRU CSW)
FE89:          139 SETKBD  EQU  $FE89     ;SETS KSW TO APPLE KEYBOARD
FF58:          140 IORTS   EQU  $FF58     ;KNOWN "RTS" LOCATION
FCBA:          141 NXTA1   EQU  $FCBA     ;INCREMENT A1H,L AND CMP TO A2H,L
FE93:          142 SETSCR  EQU  $FE93     ;SETS CSW TO APPLE SCREEN
FDF6:          143 VIDOUT  EQU  $FDF6     ;OUTPUT A CHAR TO APPLE SCREEN
0000:          144         CHN  SSC.CN00
0000:            1 *********************************
0000:            2 *                               *
0000:            3 * APPLE II SSC FIRMWARE         *
0000:            4 *                               *
0000:            5 *   BY LARRY KENYON             *
0000:            6 *                               *
0000:            7 *    -JANUARY 1981-             **************
0000:            8 *                                            *
0000:            9 * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
0000:           10 *                                            *
0000:           11 **********************************************
0000:           12 *                               *
0000:           13 * CN00 SPACE CODE               *
0000:           14 *                               *
0000:           15 *********************************
----- NEXT OBJECT FILE NAME IS SSC.DCLS.OBJ0
C700:           16         ORG  $C700
C700:           17 *
C700:2C 58 FF   18 BINIT   BIT  IORTS     ;SET THE V-FLAG
C703:70 0C      19         BVS  BENTRY    ;<ALWAYS>
C705:38         20 IENTRY  SEC             ;BASIC INPUT ENTRY
C706:90         21         DFB  $90       ;OPCODE FOR BCC
C707:18         22 OENTRY  CLC            ;BASIC OUTPUT ENTRY
C708:B8         23         CLV
C709:50 06      24         BVC  BENTRY    ;<ALWAYS> SKIP AROUND PASCAL 1.1 ENTRY
```

```
C70B:01                  DFB  $01         ;GENERIC SIGNATURE BYTE
C70C:31                  DFB  $31         ;DEVICE SIGNATURE BYTE
C70D:8E                  DFB  >PINIT
C70E:94                  DFB  >PREAD
C70F:97                  DFB  >PWRITE
C710:9A                  DFB  >PSTATUS
C711:85 27       BENTRY  STA  CHARACTER
C713:86 35               STX  ZPTEMP      ;INPUT BUFFER INDEX
C715:8A                  TXA               ;SAVE X AND Y REGS ON STACK
C716:48                  PHA
C717:98                  TYA
C718:48                  PHA
C719:08                  PHP               ;SAVE ENTRY FLAGS
C71A:78                  SEI               ;NO RUPTS DURING SLOT DETERMINATION
C71B:8D FF CF            STA  ROMSOFF     ;SWITCH OUT OTHER $C800 ROMS
C71E:20 58 FF            JSR  IORTS
C721:BA                  TSX
C722:BD 00 01            LDA  STACK,X     ;RECOVER $CN
C725:8D F8 07            STA  MSLOT
C728:AA                  TAX               ;X-REG WILL GENERALLY BE $CN
C729:0A                  ASL  A
C72A:0A                  ASL  A           ;DETERMINE $NO
C72B:0A                  ASL  A
C72C:0A                  ASL  A
C72D:85 26               STA  SLOT16
C72F:A8                  TAY               ;Y-REG WILL GENERALLY BE $NO
C730:28                  PLP               ;RESTORE RUPTS
C731:50 29               BVC  NORMIO
C733:            *
C733:            * BASIC INITIALIZATION
C733:            *
C733:1E 38 05            ASL  CMDBYTE,X ;ALWAYS ENABLE COMMANDS
C736:5E 38 05            LSR  CMDBYTE,X
C739:B9 8A C0            LDA  CMDREG,Y  ;JUST HAD A POWER-ON OR PROGRAM RESET?
C73C:29 1F               AND  #$1F
C73E:D0 05               BNE  BINIT1
C740:A9 EF               LDA  #$EF        ;IF SO, GO JOIN INIT IN PROGRESS
C742:20 05 C8            JSR  INIT1
C745:            *
C745:E4 37       BINIT1  CPX  CSWH
C747:D0 0B               BNE  FROMIN
C749:A9 07               LDA  #>OENTRY
C74B:C5 36               CMP  CSWL        ;IF CSW IS ALREADY POINTING TO OENTRY,
C74D:F0 05               BEQ  FROMIN      ; THEN WE MUST HAVE COME FROM KSW
C74F:85 36               STA  CSWL        ;OTHERWISE, SET CSW TO OENTRY
C751:18          FROMOUT CLC              ;INDICATE WE ARE CALLED FOR OUTPUT
C752:90 08               BCC  NORMIO      ;<ALWAYS>
C754:E4 39       FROMIN  CPX  KSWH        ;MAKE SURE KSW POINTS HERE
C756:D0 F9               BNE  FROMOUT     ;
C758:A9 05               LDA  #>IENTRY
C75A:85 38               STA  KSWL        ;SET UP KSW (NOTE CARRY SET FROM CPX)
C75C:            *
C75C:            * BRANCH TO APPROPRIATE BASIC I/O ROUTINE
C75C:            *
C75C:BD 38 07    NORMIO  LDA  MISCFLG,X ;SEPARATE CIC MODE FROM OTHERS
C75F:29 02               AND  #$02        ;NOT ZERO FOR CIC MODE
C761:08                  PHP              ;SAVE CIC MODE INDICATION
C762:90 03               BCC  BOUTPUT
```

```
C764:4C BF C8            JMP  BINPUT
C767:           *
C767:BD B8 04   BOUTPUT  LDA  STATEFLG,X ;CHECK FOR AFTER LOWERCASE INPUT
C76A:48                  PHA
C76B:0A                  ASL  A
C76C:10 0E               BPL  BOUTPUT1   ;SKIP IF NOT
C76E:A6 35               LDX  ZPTEMP
C770:A5 27               LDA  CHARACTER
C772:09 20               ORA  #$20
C774:9D 00 02            STA  INBUFF,X   ;RESTORE LOWERCASE IN BUFFER
C777:85 27               STA  CHARACTER  ;AND FOR OUTPUT ECHO
C779:AE F8 07            LDX  MSLOT
C77C:68         BOUTPUT1 PLA
C77D:29 BF               AND  #$BF       ;ZERO THE FLAG
C77F:9D B8 04            STA  STATEFLG,X
C782:28                  PLP             ;RETRIEVE CIC MODE INDICATION
C783:F0 06               BEQ  BOUTPUT2   ;BRANCH FOR PPC, SIC MODES
C785:20 63 CB            JSR  OUTPUT     ;CIC MODE OUTPUT
C788:4C B5 C8            JMP  CICEXIT    ;FINISH BY CHECKING FOR TERM MODE
C78B:           *
C78B:4C FC C8   BOUTPUT2 JMP SEROUT
C78E:           **********************************
C78E:           *                                *
C78E:           *  NEW PASCAL INTERFACE ENTRIES  *
C78E:           *                                *
C78E:           **********************************
C78E:20 00 C8   PINIT    JSR  PASCALINIT ;
C791:A2 00               LDX  #0         ;NO ERROR POSSIBLE
C793:60                  RTS
C794:4C 9B C8   PREAD    JMP  PASCALREAD ;
C797:4C AA C9   PWRITE   JMP  PASCALWRITE ;
C79A:           *
C79A:           * NEW PASCAL STATUS REQUEST
C79A:           *
C79A:           * A-REG=0 -> READY FOR OUTPUT?
C79A:           * A-REG=1 -> HAS INPUT BEEN RECEIVED?
C79A:           *
C79A:4A         PSTATUS  LSR  A          ;SAVE REQUEST TYPE IN CARRY
C79B:20 9B C9            JSR  PENTRY     ;(PRESERVES CARRY)
C79E:B0 08               BCS  PSTATIN
C7A0:20 F5 CA            JSR  SROUT      ;READY FOR OUTPUT?
C7A3:F0 06               BEQ  PSTATUS2
C7A5:18                  CLC
C7A6:90 03               BCC  PSTATUS2   ;CARRY CLEAR FOR NOT READY
C7A8:           *
C7A8:20 D2 CA   PSTATIN JSR  SRIN        ;SETS CARRY CORRECTLY
C7AB:BD B8 05   PSTATUS2 LDA STSBYTE,X ;GET ERROR FLAGS
C7AE:AA                  TAX
C7AF:60                  RTS
C7B0:           ***********************************************
C7B0:           * ROUTINE TO SEND A CHARACTER TO ANOTHER CARD *
C7B0:           ***********************************************
C7B0:A2 03      SENDCD   LDX  #3
C7B2:B5 36      SAVEHOOK LDA CSWL,X
C7B4:48                  PHA
C7B5:CA                  DEX
C7B6:10 FA               BPL  SAVEHOOK
C7B8:           *
```

```
C7B8:           141 * NOW PUT CARD ADDRESS IN HOOK
C7B8:           142 *
C7B8:AE F8 07   143        LDX  MSLOT
C7BB:BD 38 06   144        LDA  CHNBYTE,X
C7BE:85 36      145        STA  CSWL
C7C0:BD B8 04   146        LDA  STATEFLG,X ;GET SLOT #
C7C3:29 38      147        AND  #$38
C7C5:4A         148        LSR  A
C7C6:4A         149        LSR  A
C7C7:4A         150        LSR  A
C7C8:09 C0      151        ORA  #$C0      ;FORM $CN
C7CA:85 37      152        STA  CSWH
C7CC:           153 *
C7CC:           154 * OUTPUT TO THE PERIPHERAL
C7CC:           155 *
C7CC:8A         156        TXA             ;SAVE $CN
C7CD:48         157        PHA
C7CE:A5 27      158        LDA  CHARACTER
C7D0:48         159        PHA
C7D1:09 80      160        ORA  #$80      ;80 COL BOARDS WANT HI-BIT ON
C7D3:20 ED FD   161        JSR  COUT
C7D6:           162 *
C7D6:           163 * NOW RESTORE EVERYTHING THE OTHER CARD MAY HAVE CLOBBERED
C7D6:           164 *
C7D6:68         165        PLA
C7D7:85 27      166        STA  CHARACTER
C7D9:68         167        PLA
C7DA:8D F8 07   168        STA  MSLOT
C7DD:AA         169        TAX
C7DE:0A         170        ASL  A
C7DF:0A         171        ASL  A
C7E0:0A         172        ASL  A
C7E1:0A         173        ASL  A
C7E2:85 26      174        STA  SLOT16
C7E4:8D FF CF   175        STA  ROMSOFF
C7E7:           176 *
C7E7:           177 * PUT BACK CSWL INTO CHNBYTE
C7E7:           178 *
C7E7:A5 36      179        LDA  CSWL
C7E9:9D 38 06   180        STA  CHNBYTE,X
C7EC:           181 *
C7EC:A2 00      182        LDX  #0
C7EE:68         183 RESTORHOOK PLA
C7EF:95 36      184        STA  CSWL,X
C7F1:E8         185        INX
C7F2:E0 04      186        CPX  #4
C7F4:90 F8      187        BCC  RESTORHOOK
C7F6:           188 *
C7F6:AE F8 07   189        LDX  MSLOT
C7F9:60         190        RTS
C7FA:           191 *
C7FA:C1 D0 D0   192        ASC  "APPLE"
C7FD:CC C5
C7FF:08         193        DFB  $8
C800:           194 *
```

```
C800:           196        CHN  SSC.C800
C800:             1 *********************************
C800:             2 *                               *
C800:             3 * APPLE II SSC FIRMWARE         *
C800:             4 *                               *
C800:             5 *   BY LARRY KENYON             *
C800:             6 *                               *
C800:             7 *    -JANUARY 1981-             **************
C800:             8 *                                            *
C800:             9 * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
C800:            10 *                                            *
C800:            11 **********************************************
C800:            12 *                               *
C800:            13 * C800 SPACE: HIGH LEVEL STUFF  *
C800:            14 *                               *
C800:            15 *********************************
C800:            16 * PASCAL 1.0 INIT ENTRY *
C800:            17 ************************
----- NEXT OBJECT FILE NAME IS SSC.DCLS.OBJ1
C800:            18          ORG  $C800
C800:20 9B C9    19 PASCALINIT JSR PENTRY  ;PASCAL 1.0 INITIALIZATION ENTRY
C803:A9 16       20          LDA  #$16      ;NO XOFF, ECHO, LF EAT, OR LF GEN
C805:48          21 INIT1    PHA            ;GOES TO MISCFLG AFTER MODIFICATION
C806:A9 00       22          LDA  #0
C808:9D B8 04    23          STA  STATEFLG,X
C80B:9D B8 03    24          STA  DELAYFLG,X
C80E:9D 38 04    25          STA  HANDSHKE,X
C811:9D B8 05    26          STA  STSBYTE,X
C814:9D 38 06    27          STA  PWDBYTE,X
C817:9D B8 06    28          STA  COLBYTE,X
C81A:B9 82 C0    29          LDA  DIPSW2,Y  ;SET LF GEN OPTION FROM D2-S5
C81D:85 2B       30          STA  ZPTMP2    ;SAVE FOR LATER
C81F:4A          31          LSR  A         ;S5-> CARRY
C820:4A          32          LSR  A         ;IF S5=ON=0 THEN LEAVE MISCFLG ALONE
C821:90 04       33          BCC  INIT1A
C823:68          34          PLA            ;OTHERWISE, MAKE SURE LF GEN
C824:29 FE       35          AND  #$FE      ; ENABLE IS RESET
C826:48          36          PHA            ;
C827:B8          37 INIT1A   CLV            ;V WILL BE CLEAR FOR CIC MODE
C828:B9 81 C0    38          LDA  DIPSW1,Y
C82B:4A          39          LSR  A         ;SIC MODES SET CARRY
C82C:B0 07       40          BCS  INIT2     ;BRANCH FOR SIC MODES
C82E:4A          41          LSR  A
C82F:B0 0E       42          BCS  INIT2B    ;PPC MODE BRANCH
C831:A9 01       43          LDA  #$01      ;CTL-A
C833:D0 3D       44          BNE  INIT5     ;<ALWAYS> CIC MODE BRANCH
C835:            45 *
C835:4A          46 INIT2    LSR  A         ;SET CARRY FOR P8A
C836:A9 03       47          LDA  #$03      ;SET ETX AS DEFAULT INQUIRY CHAR
C838:B0 02       48          BCS  INIT2A    ;BRANCH FOR P8A
C83A:A9 80       49          LDA  #$80      ;FOR P8 SET AUTO CR GEN
C83C:9D B8 04    50 INIT2A   STA  STATEFLG,X
C83F:2C 58 FF    51 INIT2B   BIT  IORTS     ;SET V-FLAG FOR PPC, SIC MODES
C842:A5 2B       52          LDA  ZPTMP2
C844:29 20       53          AND  #$20      ;SET CR DELAY
C846:49 20       54          EOR  #$20      ;SO 1=ENB, 0=DISABLE
C848:9D B8 03    55          STA  DELAYFLG,X ; FROM D2-S2
C84B:            56 *
```

```
C84B:70 0A                BVS  INIT3      ;<ALWAYS> BRANCH AROUND PASCAL
C84D:           *************************
C84D:           * PASCAL 1.0 READ ENTRY *
C84D:           * (MUST BE AT $C84D)    *
C84D:           *************************
C84D:20 9B C8   PREAD0    JSR  PASCALREAD ;DO PASCAL 1.1 READ
C850:AE F8 07             LDX  MSLOT      ;MODIFY FOR 1.0
C853:9D B8 05             STA  STSBYTE,X  ;CHARACTER READ
C856:60                   RTS
C857:           ***********************
C857:           * NOW WHERE WERE WE??? *
C857:           ***********************
C857:           *
C857:A5 2B      INIT3     LDA  ZPTMP2     ;PPC, SIC MODES USE SWITCHES
C859:4A                   LSR  A          ; TO SET PWIDTH, CR DELAY
C85A:4A                   LSR  A
C85B:29 03                AND  #$03
C85D:A8                   TAY
C85E:F0 04                BEQ  INIT4
C860:           *
C860:68                   PLA             ;RESET VIDEO ENABLE FOR PWIDTH#40
C861:29 7F                AND  #$7F
C863:48                   PHA
C864:           *
C864:B9 A6 C9   INIT4     LDA  PWDTBL,Y
C867:9D 38 06             STA  PWDBYTE,X
C86A:A4 26                LDY  SLOT16
C86C:           *
C86C:68                   PLA             ;CLEAR CIC BIT IN FUTURE MISCFLG
C86D:29 95                AND  #$95       ; (AND TABBING, XOFF  AND LF EAT BITS)
C86F:48                   PHA
C870:A9 09                LDA  #$09       ;CTL-I
C872:           *
C872:9D 38 05   INIT5     STA  CMDBYTE,X  ;CMD ESC CHAR (IGNORED FOR SIC MODES)
C875:68                   PLA
C876:9D 38 07             STA  MISCFLG,X  ;SET MISCFLG FLAGS
C879:           *
C879:           * NOW FOR THE ACIA INITIALIZATION  ROUTINE
C879:           *
C879:A5 2B      INITACIA LDA ZPTMP2       ;DIPSW2
C87B:48                   PHA
C87C:29 A0                AND  #$A0       ;DATA BIT OPTIONS FOR CIC MODE
C87E:50 02                BVC  INITACIA1  ;BRANCH FOR CIC MODE
C880:29 80                AND  #$80       ;8 DATA, 1 OR 2 STOP FOR SIC, PPC
C882:20 A1 CD   INITACIA1 JSR DATACMD1    ;SET CONTROL REG
C885:20 81 CD             JSR  BAUDCMD1   ;SET DIPSWITCH BAUD RATE
C888:68                   PLA
C889:29 0C                AND  #$0C       ;PARITY OPTIONS FOR CIC MODE
C88B:50 02                BVC  INITACIA2  ;BRANCH FOR CIC MODE
C88D:A9 00                LDA  #$0        ;DISABLE PARITY FOR SIC, PPC MODES
C88F:0A         INITACIA2 ASL A
C890:0A                   ASL  A
C891:0A                   ASL  A
C892:09 0B                ORA  #$0B
C894:99 8A C0             STA  CMDREG,Y
C897:B9 88 C0             LDA  RDREG,Y    ;THROW OUT THE STRANGE STUFF
C89A:60                   RTS
C89B:           **********************
```

```
C89B:              * PASCAL READ ROUTINE *
C89B:              ************************
C89B:20 9B C9      PASCALREAD JSR PENTRY  ;SHARED BY BOTH PASCAL VERSIONS
C89E:20 AA C8      PASCALREAD1 JSR GETCHAR ;GET ACIA/KBD DATA
C8A1:29 7F                 AND  #$7F       ;CLEAR HIGH BIT FOR PASCAL
C8A3:AC F8 07      PASEXIT LDY  MSLOT
C8A6:BE B8 05              LDX  STSBYTE,Y ;ERROR STATUS-> X-REG
C8A9:60                    RTS
C8AA:              ******************************
C8AA:              * GETCHAR ROUTINE WAITS FOR  *
C8AA:              *  THE NEXT CHAR FROM EITHER *
C8AA:              *  THE ACIA OR KEYBOARD (IF  *
C8AA:              *  ENABLED).  USED BY PASCAL *
C8AA:              *  READ ROUTINE, XON WAIT,   *
C8AA:              *  AND ACK WAIT. DATA IS RE- *
C8AA:              *  TURNED IN THE A-REGISTER  *
C8AA:              ******************************
C8AA:20 FF CA      GETCHAR JSR  INPUT      ;ACIA DATA?
C8AD:B0 05                 BCS  GETCHAR1
C8AF:20 2C CC              JSR  CKKBD      ;KEYBOARD INPUT?
C8B2:90 F6                 BCC  GETCHAR
C8B4:60            GETCHAR1 RTS            ;EXIT WHEN WE HAVE SOMETHING
C8B5:              *
C8B5:                      CHN  SSC.HILEV
```

```
C8B5:           *********************************
C8B5:           *                               *
C8B5:           * APPLE II SSC FIRMWARE         *
C8B5:           *                               *
C8B5:           *   BY LARRY KENYON             *
C8B5:           *                               *
C8B5:           *    -FEBRUARY 1981-            **************
C8B5:           *                                            *
C8B5:           * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
C8B5:           *                                            *
C8B5:           **********************************************
C8B5:           *                               *
C8B5:           * CIC, SIC, PPC MODE HIGH-LEVEL *
C8B5:           *                               *
C8B5:           *********************************
C8B5:           * CIC EXIT ROUTINE . . .        *
C8B5:           *********************************
C8B5:20 1E CA   CICEXIT JSR  CHECKTERM ;SEE IF WE'VE ENTERED TERMINAL MODE
C8B8:           **********************
C8B8:           * BASIC EXIT ROUTINE *
C8B8:           **********************
C8B8:68         BASICEXIT PLA
C8B9:A8                 TAY
C8BA:68                 PLA
C8BB:AA                 TAX
C8BC:A5 27              LDA  CHARACTER
C8BE:60                 RTS
C8BF:           ************************
C8BF:           * BASIC  INPUT ROUTINE *
C8BF:           ************************
C8BF:F0 29      BINPUT  BEQ  BINACIA   ;BRANCH IF NOT CIC MODE
C8C1:BD B8 06           LDA  BUFBYTE,X ;INPUT BUFFER FULL?
C8C4:10 05              BPL  BINKBD
C8C6:5E B8 06           LSR  BUFBYTE,X ;RESET BUFFER FULL
C8C9:D0 24              BNE  BINACIA1  ;<ALWAYS>
C8CB:           *
C8CB:20 3E CC   BINKBD  JSR  GETKBD    ;KEYBOARD DATA?
C8CE:90 1A              BCC  BINACIA
C8D0:           *
C8D0:BD B8 03   BINEND  LDA  DELAYFLG,X
C8D3:29 C0              AND  #$C0      ;TRANSLATE LOWERCASE TO UPPERCASE?
C8D5:F0 0E              BEQ  BINEND1   ;IF SO, LET THE MONITOR DO IT
C8D7:A5 27              LDA  CHARACTER ;IF NOT, SET FLAG IF
C8D9:C9 E0              CMP  #$E0      ; THIS IS A LOWERCASE CHAR
C8DB:90 08              BCC  BINEND1   ; FOR INPUT BUFFER CORRECTION
C8DD:BD B8 04           LDA  STATEFLG,X ; (CIRCUMVENT APPLE MONITOR)
C8E0:09 40              ORA  #$40
C8E2:9D B8 04           STA  STATEFLG,X
C8E5:           *
C8E5:28         BINEND1 PLP
C8E6:F0 D0              BEQ  BASICEXIT ;BRANCH IF NOT CIC MODE
C8E8:D0 CB              BNE  CICEXIT   ;<ALWAYS> CHECK TO SEE IF WE
C8EA:           *                 ENTERED TERM MODE (VIA KYBD ESCAPE
C8EA:20 FF CA   BINACIA JSR  INPUT     ;ACIA DATA?
C8ED:90 DC              BCC  BINKBD
C8EF:20 11 CC   BINACIA1 JSR RESTORE   ;DO BASIC CURSED DUTY
C8F2:28                 PLP
C8F3:08                 PHP            ;GET CIC MODE INDICATOR
```

```
C8F4:F0 DA       60          BEQ  BINEND     ;SKIP IF NOT CIC MODE
C8F6:20 D1 C9    61          JSR  CKINPUT    ;LOOK FOR INPUT STREAM SPECIAL CHARS
C8F9:4C D0 C8    62          JMP  BINEND     ;
C8FC:            63 *********************************
C8FC:            64 * SIC, PPC BASIC OUTPUT ROUTINE *
C8FC:            65 *********************************
C8FC:20 1A CB    66 SEROUT   JSR  CMDSEQCK   ;CHECK FOR A COMMAND SEQUENCE
C8FF:B0 B7       67          BCS  BASICEXIT ;BRANCH IF WE WERE IN COMMAND MODE
C901:A5 27       68          LDA  CHARACTER ;SAVE CHAR ON STACK
C903:48          69          PHA
C904:BD 38 07    70          LDA  MISCFLG,X ;IF VIDEO OR TABBING ENABLED,
C907:29 C0       71          AND  #$C0       ; DON'T MESS WITH THE CURSOR
C909:D0 16       72          BNE  TABCHECK
C90B:            73 *
C90B:A5 24       74          LDA  CH         ;CHECK FOR COMMA TABBING
C90D:F0 42       75          BEQ  NOTAB      ;IF CH=0, THERE WAS NO TAB OR COMMA
C90F:C9 08       76          CMP  #8         ;INTEGER BASIC COMMA?
C911:F0 04       77          BEQ  COMMA
C913:C9 10       78          CMP  #16        ;APPLESOFT COMMA?
C915:D0 0A       79          BNE  TABCHECK
C917:09 F0       80 COMMA    ORA  #$F0
C919:3D B8 06    81          AND  COLBYTE,X ;SET COL TO PREVIOUS TAB
C91C:18          82          CLC
C91D:65 24       83          ADC  CH         ;THEN INCREMENT TO NEXT TAB
C91F:85 24       84          STA  CH
C921:            85 *
C921:            86 *
C921:BD B8 06    87 TABCHECK LDA  COLBYTE,X
C924:C5 24       88          CMP  CH         ;IS TABBING NEEDED?
C926:F0 29       89          BEQ  NOTAB      ;IF EQUAL THEN NO TAB NEEDED
C928:A9 A0       90          LDA  #$A0       ;SPACE FOR FORWARD TAB
C92A:90 08       91          BCC  TAB1
C92C:BD 38 07    92          LDA  MISCFLG,X ;DON'T BACKSPACE UNLESS TABBING
C92F:0A          93          ASL  A          ; OPTION IS ENABLED
C930:10 1F       94          BPL  NOTAB
C932:A9 88       95          LDA  #$88       ;BACKSPACE FOR BACKTAB
C934:85 27       96 TAB1     STA  CHARACTER
C936:2C 58 FF    97          BIT  IORTS      ;SET V=1 TO INDICATE TABBING
C939:08          98          PHP             ;SAVE TABBING INDICATOR
C93A:70 0C       99          BVS  TAB2       ;<ALWAYS> AROUND BATCH MOVE ENTRY
C93C:EA         100          NOP
C93D:           101 *************************
C93D:           102 * SHORT BATCH MOVE:     *
C93D:           103 *  LOCATE AT $C93D FOR  *
C93D:           104 *  COMPATIBILITY WITH   *
C93D:           105 *  SIC P8 BLOCK MOVE.   *
C93D:           106 *************************
C93D:2C 58 FF   107 BATCHIN BIT  IORTS
C940:50         108          DFB  $50        ;DUMMY BVC
C941:B8         109 BATCHOUT CLV             ;V=0 FOR OUTPUT ENTRY
C942:AE F8 07   110          LDX  MSLOT
C945:4C EF C9   111          JMP  BATCHIO
C948:           112 *********************
C948:           113 * BURP . . .        *
C948:           114 *********************
C948:20 B5 C9   115 TAB2     JSR  ADJUST     ;ADJUST COLUMN COUNT
C94B:20 6B CB   116          JSR  OUTPUT2    ;DON'T GO TO SCREEN WHEN TABBING
C94E:4C 68 C9   117          JMP  FORCECR    ;SHARE SOME CODE. . .
```

```
C951:          *
C951:68        NOTAB   PLA
C952:B8                CLV
C953:08                PHP                   ;SAVE 'NO TAB' INDICATION
C954:85 27     NOTAB1  STA   CHARACTER ;(FORCE CR REENTRY)
C956:48                PHA
C957:20 68 CB          JSR   OUTPUT1   ;ENTER AFTER CMD SEQ CHECK
C95A:20 B5 C9          JSR   ADJUST
C95D:68                PLA
C95E:49 8D             EOR   #$8D      ;WAS IT A CR?
C960:0A                ASL   A
C961:D0 05             BNE   FORCECR
C963:9D B8 06          STA   COLBYTE,X ;IF SO, RESET COLUMN TO 0
C966:85 24             STA   CH
C968:          *
C968:BD B8 04  FORCECR LDA   STATEFLG,X ;FORCE CR DISABLED?
C96B:10 0D             BPL   SEREND
C96D:BD 38 06          LDA   PWDBYTE,X ;FORCE CR IF LIMIT REACHED
C970:F0 08             BEQ   SEREND    ;(FOR P8 POKE COMPATIBILITY)
C972:18                CLC
C973:FD B8 06          SBC   COLBYTE,X
C976:A9 8D             LDA   #$8D
C978:90 DA             BCC   NOTAB1    ;BRANCH TO FORCE CR
C97A:          *
C97A:28        SEREND  PLP
C97B:70 A4             BVS   TABCHECK  ;BRANCH IF TABBING
C97D:          *
C97D:BD 38 07          LDA   MISCFLG,X ;DON'T MESS WITH CURSOR
C980:30 16             BMI   SEREND2   ; WHEN VIDEO IS ON
C982:BC B8 06          LDY   COLBYTE,X
C985:0A                ASL   A
C986:30 0E             BMI   SETCH     ;SET CH TO VALUE OF COL FOR TABBING
C988:98                TYA
C989:A0 00             LDY   #0
C98B:38                SEC
C98C:FD 38 06          SBC   PWDBYTE,X ;
C98F:C9 F8             CMP   #$F8      ;WITHIN 8 CHARS OF PWIDTH?
C991:90 03             BCC   SETCH
C993:69 27             ADC   #$27      ;IF SO, ADJUST TO WITHIN 8 OF 40
C995:A8                TAY
C996:84 24     SETCH   STY   CH
C998:          *
C998:4C B8 C8  SEREND2 JMP   BASICEXIT ;THAT'S ALL
C99B:          *
C99B:          ***************************
C99B:          * PASCAL ENTRY ROUTINE    *
C99B:          ***************************
C99B:8E F8 07  PENTRY  STX   MSLOT
C99E:84 26             STY   SLOT16
C9A0:A9 00             LDA   #0
C9A2:9D B8 05          STA   STSBYTE,X
C9A5:60                RTS
C9A6:          *
C9A6:          *******************************
C9A6:          * SIC MODE PRINTER WIDTH TABLE *
C9A6:          *******************************
C9A6:29        PWDTBL  DFB   $29       ;40 COLUMNS
C9A7:48                DFB   $48       ;72 COLUMNS
```

```
C9A8:50                  DFB  $50       ;80 COLUMNS
C9A9:84                  DFB  $84       ;132 COLUMNS
C9AA:           ************************
C9AA:           * PASCAL WRITE ROUTINE *
C9AA:           * (DOUBLES AS PASCAL   *
C9AA:           *  1.0 ENTRY POINT)    *
C9AA:           *  -MUST BE AT $C9AA-  *
C9AA:           ************************
C9AA:85 27      PASCALWRITE STA CHARACTER
C9AC:20 9B C9            JSR  PENTRY
C9AF:20 63 CB            JSR  OUTPUT
C9B2:4C A3 C8            JMP  PASEXIT   ;LOAD X-REG WITH ERROR BYTE & RTS
C9B5:           *
C9B5:           ******************************
C9B5:           * COLUMN ADJUST ROUTINE      *
C9B5:           * (PPC, SIC MODES ONLY)      *
C9B5:           ******************************
C9B5:A5 27      ADJUST   LDA  CHARACTER
C9B7:49 08               EOR  #$08      ;BACKSPACE?
C9B9:0A                  ASL  A
C9BA:F0 04               BEQ  DECRCOL   ;IF SO, DECREMENT COLUMN
C9BC:49 EE               EOR  #$EE      ;DELETE? ($FF, RUB)
C9BE:D0 09               BNE  CTRLTST
C9C0:DE B8 06   DECRCOL  DEC  COLBYTE,X ;DECREMENT COLUMN COUNT
C9C3:10 03               BPL  ADJRTS
C9C5:9D B8 06            STA  COLBYTE,X ;DON'T ALLOW TO GO BELOW 0
C9C8:60         ADJRTS   RTS
C9C9:C9 C0      CTRLTST  CMP  #$C0      ;DON'T INCREMENT COLUMN COUNT FOR
C9CB:B0 FB               BCS  ADJRTS    ; CONTROL CHARACTERS
C9CD:FE B8 06            INC  COLBYTE,X
C9D0:60                  RTS
C9D1:           *******************************************
C9D1:           * ROUTINE TO PROCESS SPECIAL INPUT CHARS *
C9D1:           *******************************************
C9D1:BD 38 07   CKINPUT  LDA  MISCFLG,X
C9D4:29 08               AND  #$08      ;INPUT CTL CHARS ENABLED?
C9D6:F0 16               BEQ  CIEND
C9D8:           *
C9D8:BD B8 04            LDA  STATEFLG,X
C9DB:A4 27               LDY  CHARACTER
C9DD:C0 94               CPY  #$94      ;CTL-T?
C9DF:D0 04               BNE  CKINPUT1
C9E1:09 80               ORA  #$80      ;SET TERMINAL MODE
C9E3:D0 06               BNE  CKINPUT2  ;<ALWAYS>
C9E5:           *
C9E5:C0 92      CKINPUT1 CPY  #$92      ;CONTROL-R?
C9E7:D0 05               BNE  CIEND
C9E9:29 7F               AND  #$7F      ;RESET TERMINAL MODE
C9EB:9D B8 04   CKINPUT2 STA  STATEFLG,X
C9EE:60         CIEND    RTS
C9EF:           *
```

```
C9EF:                   CHN  SSC.TERM
C9EF:           **********************************
C9EF:           *                                *
C9EF:           * APPLE II SSC FIRMWARE          *
C9EF:           *                                *
C9EF:           *   BY LARRY KENYON              *
C9EF:           *                                *
C9EF:           *     -APRIL 1981-               **************
C9EF:           *                                             *
C9EF:           * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
C9EF:           *                                             *
C9EF:           **********************************************
C9EF:           * SHORT BLOCK MOVE     *
C9EF:           ***********************
C9EF:8A         BATCHIO TXA
C9F0:0A                 ASL  A
C9F1:0A                 ASL  A
C9F2:0A                 ASL  A
C9F3:0A                 ASL  A
C9F4:85 26              STA  SLOT16
C9F6:A9 00              LDA  #0
C9F8:9D B8 05           STA  STSBYTE,X ;ZERO ERROR INDICATION
C9FB:70 0F              BVS  MOVIN
C9FD:           *
C9FD:A0 00      MOVOUT  LDY  #0
C9FF:B1 3C              LDA  (A1L),Y   ;GET BUFFER DATA
CA01:85 27              STA  CHARACTER
CA03:20 02 CC           JSR  ACIAOUT   ;SEND IT OUT THE ACIA
CA06:20 BA FC           JSR  NXTA1
CA09:90 F2              BCC  MOVOUT
CA0B:60                 RTS
CA0C:           *
CA0C:20 D2 CA   MOVIN   JSR  SRIN
CA0F:90 FB              BCC  MOVIN
CA11:B9 88 C0           LDA  RDREG,Y
CA14:A0 00              LDY  #0
CA16:91 3C              STA  (A1L),Y   ;PUT ACIA DATA INTO BUFFER
CA18:20 BA FC           JSR  NXTA1
CA1B:90 EF              BCC  MOVIN
CA1D:60                 RTS
CA1E:           *
CA1E:           **********************************
CA1E:           *                                *
CA1E:           *  TERMINAL MODE ROUTINES        *
CA1E:           *                                *
CA1E:           **********************************
CA1E:BD B8 04   CHECKTERM LDA STATEFLG,X ;HAVE WE ENTERED TERMINAL MODE?
CA21:10 31              BPL  TERMRTS   ;IF NOT, A SIMPLE RTS WILL DO. . .
CA23:           *
CA23:           * WE ENTER THE WORLD OF TERMINAL MODE
CA23:           *
CA23:A9 02      TERMMODE LDA #$02      ;START IN SHIFT-LOCK STATE
CA25:48                 PHA            ;SHIFT STATE IS SAVED ON STACK
CA26:A9 7F              LDA  #$7F
CA28:20 E2 CD           JSR  KCMD1     ;RESET ECHO (DEFAULT TO FULL DUP)
CA2B:           *
CA2B:A4 24      TERMNEXT LDY CH
CA2D:B1 28              LDA  (BASL),Y
```

```
CA2F:85 27                STA  CHARACTER ;SAVE SCREEN CHARACTER
CA31:A9 07       TERMNEXT1 LDA #$07      ;IMPLEMENT A FLASHING UNDERLINE
CA33:25 4F                AND  RNDH      ; FOR A CURSOR
CA35:D0 10                BNE  TERMNEXT3
CA37:A4 24                LDY  CH
CA39:A9 DF                LDA  #$DF
CA3B:D1 28                CMP  (BASL),Y  ;IS UNDERLINE ON THE SCREEN?
CA3D:D0 02                BNE  TERMNEXT2 ;IF NOT, PUT IT THERE
CA3F:A5 27                LDA  CHARACTER ;OTHERWISE USE TRUE SCREEN CHAR
CA41:91 28       TERMNEXT2 STA (BASL),Y
CA43:E6 4F                INC  RNDH      ;MAKE IT FLASH, BUT
CA45:E6 4F                INC  RNDH      ;NOT TOO SLOW AND NOT TOO FAST
CA47:            *
CA47:BD B8 04    TERMNEXT3 LDA STATEFLG,X ;ARE WE STILL IN TERM MODE?
CA4A:30 09                BMI  TERMACIAIN ;IF SO, GO CHECK ACIA
CA4C:            *
CA4C:20 11 CC    TERMEXIT JSR RESTORE    ;ALWAYS REPLACE OUR CURSOR
CA4F:68                   PLA            ;CLEAN UP THE STACK
CA50:A9 8D                LDA  #$8D      ;RETURN A <CR> TO COVER UP
CA52:85 27                STA  CHARACTER
CA54:60          TERMRTS RTS
CA55:            *
CA55:20 FF CA    TERMACIAIN JSR INPUT    ;ACIA INPUT?
CA58:90 0C                BCC  TERMKBDIN ;IF NOT, GO CHECK KEYBOARD
CA5A:20 11 CC             JSR  RESTORE   ;RESTORE CURSOR, INPUT->CHARACTER
CA5D:20 D1 C9             JSR  CKINPUT   ;CHECK FOR CTL-T, CTL-R
CA60:20 A3 CC             JSR  SCREENOUT1 ;INPUT->SCREEN ALWAYS
CA63:4C 2B CA             JMP  TERMNEXT  ;
CA66:            *
CA66:20 3E CC    TERMKBDIN JSR GETKBD    ;KEYPRESS?
CA69:90 C6                BCC  TERMNEXT1 ;SKIP IF NOT
CA6B:70 BE                BVS  TERMNEXT  ;BRANCH  IF WE DID A KBD ESCAPE SEQ.
CA6D:BD 38 07             LDA  MISCFLG,X ;SHIFTING ENABLED?
CA70:0A                   ASL  A
CA71:10 22                BPL  TERMSEND1
CA73:68                   PLA            ;RECOVER TERMSTATE
CA74:A8                   TAY
CA75:A5 27                LDA  CHARACTER
CA77:C0 01                CPY  #1        ;1 = SHIFT LETTERS, XLATE NUMBERS
CA79:F0 20                BEQ  TERMCAP
CA7B:B0 34                BCS  TERMLOCK  ;2 MEANS CAPS LOCK MODE
CA7D:            *
CA7D:C9 9B       TERMNORM CMP #$9B       ;ESC?
CA7F:D0 06                BNE  TERMLETTER
CA81:            *
CA81:C8          TERMINC INY             ;INCREMENT STATE
CA82:98          TERMINC1 TYA
CA83:48                   PHA            ;PUT BACK ON STACK
CA84:4C 2B CA             JMP  TERMNEXT
CA87:            *
CA87:C9 C1       TERMLETTER CMP #$C1     ;<A?
CA89:90 08                BCC  TERMSEND
CA8B:C9 DB                CMP  #$DB      ;>Z?
CA8D:B0 04                BCS  TERMSEND
CA8F:09 20                ORA  #$20      ;IT'S A LETTER SO TRANSLATE TO LC
CA91:85 27                STA  CHARACTER
CA93:            *
CA93:98          TERMSEND TYA
```

```
CA94:48                   PHA             ;PUT STATE BACK ON STACK
CA95:20 68 CB   TERMSEND1 JSR OUTPUT1     ;GO OUTPUT
CA98:4C 2B CA             JMP  TERMNEXT
CA9B:           *
CA9B:C9 9B      TERMCAP CMP   #$9B        ;TWO ESCAPES?
CA9D:F0 E2                BEQ  TERMINC
CA9F:C9 B0                CMP  #$B0       ;<0?
CAA1:90 0A                BCC  TERMCAP1
CAA3:C9 BB                CMP  #$BB       ;>COLON?
CAA5:B0 06                BCS  TERMCAP1
CAA7:           *
CAA7:           * ESC <NUMBER> SO TRANSLATE INTO MISSING ASCII CHAR
CAA7:           *
CAA7:A8                   TAY
CAA8:B9 09 CA             LDA  TRANSLATE-$B0,Y
CAAB:85 27                STA  CHARACTER
CAAD:A0 00      TERMCAP1 LDY #0           ;BACK TO STATE 0
CAAF:F0 E2                BEQ  TERMSEND   ;<ALWAYS>
CAB1:           *
CAB1:C9 9B      TERMLOCK CMP #$9B         ;ESC?
CAB3:D0 DE                BNE  TERMSEND
CAB5:A0 00                LDY  #0
CAB7:F0 C9                BEQ  TERMINC1;<ALWAYS>
CAB9:           *
CAB9:           ****************************
CAB9:           * TRANSLATE TABLE          *
CAB9:           ****************************
CAB9:9B         TRANSLATE DFB $9B         ;ESC
CABA:9C                   DFB  $9C        ;FS
CABB:9F                   DFB  $9F        ;US
CABC:DB                   DFB  $DB        ;LEFT BRACKET
CABD:DC                   DFB  $DC        ;LEFT SLASH
CABE:DF                   DFB  $DF        ;UNDERSCORE
CABF:FB                   DFB  $FB        ;LEFT ENCLOSE
CAC0:FC                   DFB  $FC        ;VERTICAL BAR
CAC1:FD                   DFB  $FD        ;RIGHT ENCLOSE
CAC2:FE                   DFB  $FE        ;TILDE
CAC3:FF                   DFB  $FF        ;RUB
CAC4:           *
CAC4:                     CHN  SSC.CORE
```

```
CAC4:             *********************************
CAC4:             *                               *
CAC4:             * APPLE II SSC FIRMWARE         *
CAC4:             *                               *
CAC4:             *   BY LARRY KENYON             *
CAC4:             *                               *
CAC4:             *    -JANUARY 1981-             **************
CAC4:             *                                            *
CAC4:             * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
CAC4:             *                                            *
CAC4:             **********************************************
CAC4:             *                               *
CAC4:             * CORE SUBROUTINES              *
CAC4:             *                               *
CAC4:             *********************************
CAC4:             *********************************
CAC4:             * GENERAL PURPOSE WAIT ROUTINE  *
CAC4:             *********************************
CAC4:             *
CAC4:             * WAITMS WAITS FOR [A-REG] MILLISECONDS (256 IF A-REG=0)
CAC4:             *
CAC4:A2 CA        WAITMS  LDX  #202
CAC6:CA           WAITMS1 DEX            ;<DON'T LET THIS LOOP CROSS A PAGE>
CAC7:D0 FD                BNE  WAITMS1   ;5 MICROSECOND LOOP
CAC9:38                   SEC
CACA:E9 01                SBC  #01
CACC:D0 F6                BNE  WAITMS
CACE:AE F8 07             LDX  MSLOT
CAD1:60                   RTS
CAD2:             **************************************
CAD2:             * ACIA STATUS REGISTER READ ROUTINES *
CAD2:             **************************************
CAD2:             *
CAD2:             *   SRIN USED TO CHECK ACIA INPUT STATUS
CAD2:             *
CAD2:A4 26        SRIN    LDY  SLOT16    ;SLOT16=$N0
CAD4:B9 89 C0             LDA  STREG,Y
CAD7:48                   PHA
CAD8:29 20                AND  #$20      ;DCD?
CADA:4A                   LSR  A         ;AN ERROR IF NOT
CADB:4A                   LSR  A
CADC:85 35                STA  ZPTEMP
CADE:68                   PLA
CADF:29 0F                AND  #$0F
CAE1:C9 08                CMP  #$08      ;SET CARRY IF RDR FULL, ELSE CLEAR
CAE3:90 04                BCC  SRIN1
CAE5:29 07                AND  #$07      ;PE, FE, OVR VALID ONLY WHEN RDR=1
CAE7:B0 02                BCS  SRIN2     ;<ALWAYS>
CAE9:A5 35        SRIN1   LDA  ZPTEMP
CAEB:05 35        SRIN2   ORA  ZPTEMP    ;GET DCD ERROR BIT
CAED:F0 05                BEQ  SRIN3     ;BRANCH IF NO ERRORS FOUND
CAEF:09 20                ORA  #$20      ;ELSE SET BIT 5 TO OFFSET FOR PASCAL
CAF1:9D B8 05             STA  STSBYTE,X ;AND SAVE IN STATUS TEMP
CAF4:60           SRIN3   RTS            ;CY=1 MEANS DATA IS AVAILABLE
CAF5:             *
CAF5:             * SROUT CHECKS IF TDR IS EMPTY + HARDWARE HANDSHAKE IS OK
CAF5:             *
CAF5:A4 26        SROUT   LDY  SLOT16
```

```
CAF7:B9 89 C0            LDA  STREG,Y
CAFA:29 70               AND  #$70
CAFC:C9 10               CMP  #$10       ;EQU IF TDR EMPTY, DCD, DSR, & CTS
CAFE:60                  RTS
CAFF:           *
CAFF:           ************************
CAFF:           * GENERAL INPUT ROUTINE *
CAFF:           ************************
CAFF:20 D2 CA   INPUT    JSR  SRIN
CB02:90 15               BCC  NOINPUT1
CB04:           *
CB04:B9 88 C0            LDA  RDREG,Y    ;GET THE ACIA INPUT
CB07:09 80               ORA  #$80       ;SET HI BIT FOR BASIC
CB09:C9 8A               CMP  #$8A       ;LINEFEED?
CB0B:D0 09               BNE  INPUT2
CB0D:           *
CB0D:A8                  TAY
CB0E:BD 38 07            LDA  MISCFLG,X ;SEE IF WE SHOULD EAT IT
CB11:29 20               AND  #$20
CB13:D0 03               BNE  NOINPUT    ;IF SO, JUST KEEP IT A SECRET
CB15:98                  TYA
CB16:           *
CB16:38         INPUT2   SEC             ;INDICATE DATA
CB17:60                  RTS
CB18:           *
CB18:18         NOINPUT CLC              ;CARRY CLEAR FOR NO INPUT
CB19:60         NOINPUT1 RTS
CB1A:           *
CB1A:           *************************
CB1A:           * GENERAL OUTPUT ROUTINE *
CB1A:           *************************
CB1A:           *
CB1A:           * START OF COMMAND CHECK ROUTINE
CB1A:           *
CB1A:A4 26      CMDSEQCK LDY SLOT16
CB1C:B9 81 C0            LDA  DIPSW1,Y
CB1F:4A                  LSR  A
CB20:B0 36               BCS  NOCMD      ;DON'T WORRY ABOUT CMD SEQ FOR SIC
CB22:BD B8 04            LDA  STATEFLG,X
CB25:29 07               AND  #$07       ;ARE WE IN A COMMAND SEQUENCE?
CB27:F0 05               BEQ  ESCCHECK
CB29:20 FC CD            JSR  CMDPROC    ;IF SO, GOTO COMMAND CENTRAL
CB2C:38                  SEC             ;INDICATE COMMAND
CB2D:60                  RTS
CB2E:           *
CB2E:A5 27      ESCCHECK LDA CHARACTER
CB30:29 7F               AND  #$7F       ;IGNORE HIGH BIT
CB32:DD 38 05            CMP  CMDBYTE,X ;IS THIS BEGINNING OF A CMD SEQ?
CB35:D0 05               BNE  XOFFCK
CB37:FE B8 04            INC  STATEFLG,X ;START UP COMMAND MODES
CB3A:38                  SEC             ;INDICATE COMMAND
CB3B:60                  RTS
CB3C:           *
CB3C:BD 38 07   XOFFCK   LDA  MISCFLG,X ;IS XON ENABLED?
CB3F:29 08               AND  #$08
CB41:F0 15               BEQ  NOCMD      ;SKIP THIS IF NOT
CB43:           *
CB43:20 FF CA            JSR  INPUT      ;ANY INPUT?
```

```
CB46:90 10                BCC  NOCMD      ;IF NOT, GO OUTPUT
CB48:C9 93                CMP  #$93       ;IS IT AN XOFF?
CB4A:F0 0E                BEQ  XONWAIT    ;IF SO, GO WAIT FOR ANOTHER INPUT
CB4C:48                   PHA
CB4D:BD 38 07             LDA  MISCFLG,X ;CIC MODE?
CB50:4A                   LSR  A
CB51:4A                   LSR  A
CB52:68                   PLA
CB53:90 04                BCC  ANRTS
CB55:9D B8 06             STA  BUFBYTE,X ;IF SO, WE HAVE A BUFFER
CB58:18          NOCMD    CLC             ;INDICATE NOT A CMD SEQ
CB59:60          ANRTS    RTS
CB5A:            *
CB5A:20 AA C8    XONWAIT  JSR  GETCHAR    ;GET ACIA/KBD DATA
CB5D:C9 91                CMP  #$91       ;IS IT AN XON?
CB5F:D0 F9                BNE  XONWAIT    ;IF NOT, WAIT
CB61:18                   CLC             ;OTHERWISE, INDICATE NOT A CMD SEQ
CB62:60                   RTS             ; AND RETURN
CB63:            **************************************************
CB63:            * NOW THE OUTPUT ROUTINE YOU'VE BEEN WAITING FOR *
CB63:            **************************************************
CB63:20 1A CB    OUTPUT   JSR  CMDSEQCK
CB66:B0 F1                BCS  ANRTS      ;DON'T OUTPUT COMMAND SEQUENCES
CB68:            *
CB68:20 9E CC    OUTPUT1  JSR  SCREENOUT
CB6B:            *
CB6B:A4 26       OUTPUT2  LDY  SLOT16
CB6D:B9 81 C0             LDA  DIPSW1,Y
CB70:4A                   LSR  A
CB71:90 4E                BCC  OUTPUT3    ;SKIP ETX/ACK FOR NATIVE MODES
CB73:4A                   LSR  A
CB74:90 4B                BCC  OUTPUT3    ;BRANCH IF NOT P8A EMULATION
CB76:            *
CB76:            ********************
CB76:            * P8A ETX/ACK STUFF*
CB76:            ********************
CB76:            * AFTER 148 CHARACTERS BUT NOT WITHIN AN ESCAPE SEQUENCE
CB76:            * OF UP TO 5 CHARACTERS, THE HANDSHAKE IS PERFORMED
CB76:            * (WILL DELAY UNTIL 'NOT ESC' AND THEN 4 MORE CHARS
CB76:            *  OR UNTIL AN 'ESC')
CB76:            *
CB76:A5 27       P8AOUT1  LDA  CHARACTER ;SAVE CHAR ON STACK
CB78:48                   PHA
CB79:BD 38 04             LDA  HANDSHKE,X ;CHAR COUNT FOR BUFFER FULL
CB7C:C9 67                CMP  #103       ;IF <103 THEN 153 CHARS IN BUFFER
CB7E:90 10                BCC  ETX
CB80:C9 6C                CMP  #108       ;IF >=108 THEN LESS THAN 149 CHARS
CB82:B0 22                BCS  P8AOUT2    ; SO NO HANDSHAKE IS NEEDED YET
CB84:C9 6B                CMP  #107       ;SETS CARRY IF 107 (149 SENT)
CB86:68                   PLA
CB87:48                   PHA
CB88:49 9B                EOR  #$9B       ;ESC?
CB8A:29 7F                AND  #$7F       ;IGNORE HI-BIT
CB8C:D0 18                BNE  P8AOUT2    ;COUNT AS 1 OF 5 IF NOT 'ESC'
CB8E:B0 19                BCS  P8AOUT3    ;DON'T COUNT IF 149TH CHAR IS 'ESC'
CB90:            *
CB90:BD B8 04    ETX      LDA  STATEFLG,X ;SEND QUERY CHAR TO PRINTER
CB93:29 1F                AND  #$1F       ;(DEFAULT IS ETX)
```

```
CB95:09 80      176          ORA  #$80
CB97:85 27      177          STA  CHARACTER
CB99:20 02 CC   178          JSR  ACIAOUT
CB9C:20 AA C8   179 ACK      JSR  GETCHAR     ;GET ACIA/KBD DATA
CB9F:49 86      180          EOR  #$86        ;ACK?
CBA1:D0 ED      181          BNE  ETX         ;IF NOT ACK, REPEAT HANDSHAKE
CBA3:9D 38 04   182          STA  HANDSHKE,X ;INIT CHAR COUNT TO 255
CBA6:           183 *
CBA6:DE 38 04   184 P8AOUT2 DEC  HANDSHKE,X
CBA9:68         185 P8AOUT3 PLA               ;GET REAL CHAR TO OUTPUT
CBAA:85 27      186          STA  CHARACTER
CBAC:49 8D      187          EOR  #$8D        ;IF CR AND CR DELAY MODE
CBAE:0A         188          ASL  A
CBAF:D0 0A      189          BNE  P8AOUT4     ; THEN FAKE CHAR COUNT TO LESS THAN
CBB1:BD B8 03   190          LDA  DELAYFLG,X ; 48 TO FORCE HANDSHAKE ON NEXT
CBB4:29 30      191          AND  #$30        ; CHARACTER OUT
CBB6:F0 03      192          BEQ  P8AOUT4
CBB8:9D 38 04   193          STA  HANDSHKE,X
CBBB:           194 *
CBBB:20 02 CC   195 P8AOUT4 JSR  ACIAOUT
CBBE:4C EA CB   196          JMP  LFGEN       ;(SKIP DELAYS)
CBC1:           197 *****************************
CBC1:           198 * AND BACK TO NORMAL OUTPUT *
CBC1:           199 *****************************
CBC1:20 02 CC   200 OUTPUT3 JSR  ACIAOUT     ;OUTPUT THE CHARACTER
CBC4:           201 *
CBC4:           202 * NOW CHECK FOR CR, LF, AND FF DELAYS
CBC4:           203 *
CBC4:0A         204          ASL  A
CBC5:A8         205          TAY
CBC6:BD B8 03   206          LDA  DELAYFLG,X ;GET DELAY FLAGS
CBC9:C0 18      207          CPY  #$18        ;FORM FEED?
CBCB:F0 0C      208          BEQ  OUTDLY1
CBCD:4A         209          LSR  A
CBCE:4A         210          LSR  A           ;RIGHT JUSTIFY LF DELAY
CBCF:C0 14      211          CPY  #$14        ;LINE FEED?
CBD1:F0 06      212          BEQ  OUTDLY1
CBD3:4A         213          LSR  A
CBD4:4A         214          LSR  A           ;RIGHT JUSTIFY CR DELAY
CBD5:C0 1A      215          CPY  #$1A        ;CARRIAGE RETURN?
CBD7:D0 25      216          BNE  OUTPUTEND
CBD9:29 03      217 OUTDLY1 AND  #$03        ;JUST WANT LOWEST 2 BITS
CBDB:F0 0D      218          BEQ  LFGEN       ;NO DELAY INDICATED
CBDD:A8         219          TAY
CBDE:B9 FE CB   220          LDA  DLYTBL-1,Y
CBE1:A8         221          TAY              ;DELAY IN 32 MSEC INCREMENTS
CBE2:A9 20      222 OUTDLYLP LDA #32          ;
CBE4:20 C4 CA   223          JSR  WAITMS
CBE7:88         224          DEY
CBE8:D0 F8      225          BNE  OUTDLYLP
CBEA:           226 *
CBEA:           227 * CHECK ON LF GENERATION OPTION
CBEA:           228 *
CBEA:A5 27      229 LFGEN    LDA  CHARACTER
CBEC:0A         230          ASL  A
CBED:C9 1A      231          CMP  #$1A        ;CARRIAGE RETURN?
CBEF:D0 0D      232          BNE  OUTPUTEND
CBF1:BD 38 07   233          LDA  MISCFLG,X ;IS LF GENERATE ENABLED?
```

```
CBF4:6A                  ROR  A
CBF5:90 07               BCC  OUTPUTEND
CBF7:A9 8A               LDA  #$8A
CBF9:85 27               STA  CHARACTER ;LINE FEED
CBFB:4C 6B CB            JMP  OUTPUT2   ;(DON'T ECHO IT)
CBFE:60         OUTPUTEND RTS
CBFF:           *
CBFF:01         DLYTBL   DFB  $01       ;32 MSEC
CC00:08                  DFB  $08       ;1/4 SEC
CC01:40                  DFB  $40       ; 2  SEC
CC02:           **************************
CC02:           * ACIA OUTPUT ROUTINE    *
CC02:           **************************
CC02:20 F5 CA   ACIAOUT  JSR  SROUT     ;READY FOR OUTPUT?
CC05:D0 FB               BNE  ACIAOUT
CC07:98                  TYA
CC08:09 89               ORA  #$89      ;PREPARE TO ADDRESS ACIA,
CC0A:A8                  TAY            ; CAUSING 6502 FALSE READ TO OCCUR
CC0B:A5 27               LDA  CHARACTER ; ON PAGE $BF (AVOIDING RDR READ)
CC0D:99 FF BF            STA  $BFFF,Y   ;HERE YOU ARE ACIA
CC10:60                  RTS
CC11:           *
CC11:           ***********************************
CC11:           * RESTORE CURSOR (NOT FOR PASCAL) *
CC11:           * (A-REG SHOULD CONTAIN NEW CHAR) *
CC11:           ***********************************
CC11:48         RESTORE  PHA            ;SAVE NEW CHARACTER
CC12:A4 24               LDY  CH
CC14:A5 27               LDA  CHARACTER ;OLD CHARACTER
CC16:91 28               STA  (BASL),Y
CC18:68                  PLA
CC19:           *
CC19:C9 95               CMP  #$95      ;SCREEN PICK?
CC1B:D0 0C               BNE  RESTOREND
CC1D:A5 27               LDA  CHARACTER ;IF SO, USE SCREEN CHAR
CC1F:C9 20               CMP  #$20      ;INVERSE?
CC21:B0 06               BCS  RESTOREND
CC23:20 DF CC            JSR  GETXLATE  ;REVERSE THE TRANSLATION
CC26:59 DB CC            EOR  REVMASK,Y
CC29:85 27      RESTOREND STA CHARACTER
CC2B:60                  RTS
CC2C:           *
CC2C:                    CHN  SSC.UTIL
```

```
CC2C:           *********************************
CC2C:           *                               *
CC2C:           * APPLE II SSC FIRMWARE         *
CC2C:           *                               *
CC2C:           *   BY LARRY KENYON             *
CC2C:           *                               *
CC2C:           *    -JANUARY 1981-             **************
CC2C:           *                                            *
CC2C:           * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
CC2C:           *                                            *
CC2C:           **********************************************
CC2C:           *                               *
CC2C:           * UTILITY ROUTINES              *
CC2C:           *                               *
CC2C:           *********************************
CC2C:           * PASCAL-BASIC KEYBOARD FETCH *
CC2C:           *******************************
CC2C:18         CKKBD   CLC                ;RETURN CARRY CLEAR FOR NO DATA
CC2D:BD 38 07           LDA  MISCFLG,X
CC30:29 04              AND  #$04          ;ANSWER NO IF KEYBOARD IS DISABLED
CC32:F0 09              BEQ  CKKBDXIT
CC34:           *
CC34:AD 00 C0   CKKBD1  LDA  KBD
CC37:10 04              BPL  CKKBDXIT
CC39:8D 10 C0           STA  KBDSTRB
CC3C:38                 SEC                ;INDICATE DATA
CC3D:60         CKKBDXIT RTS
CC3E:           *******************************************
CC3E:           * GET A CHAR FROM KEYBOARD FOR BASIC ONLY  *
CC3E:           *******************************************
CC3E:E6 4E      GETKBD  INC  RNDL          ;MIX UP RANDOM # SEED
CC40:D0 02              BNE  GETKBD1       ; FOR BASIC
CC42:E6 4F              INC  RNDH
CC44:20 2C CC   GETKBD1 JSR  CKKBD         ;KEYBOARD FETCH ROUTINE
CC47:B8                 CLV                ;INDICATE NO ESCAPE SEQUENCE
CC48:90 F3              BCC  CKKBDXIT      ;EXIT IF NO KEY PRESS
CC4A:20 11 CC           JSR  RESTORE       ;DO BASIC CURSED DUTY
CC4D:29 7F              AND  #$7F
CC4F:DD 38 05           CMP  CMDBYTE,X ;IS IT THE START OF A COMMAND?
CC52:D0 3D              BNE  GETKBDONE ;IF NOT, EXIT INDICATING DATA
CC54:A4 26              LDY  SLOT16
CC56:B9 81 C0           LDA  DIPSW1,Y  ;ONLY DO CMD ESC FOR PPC, SIC MODES
CC59:4A                 LSR  A
CC5A:B0 35              BCS  GETKBDONE
CC5C:           ***************************
CC5C:           * KEYBOARD ESCAPE HANDLER *
CC5C:           ***************************
CC5C:A0 0A      KBDESC  LDY  #$A           ;FIRST PRINT A PROMPT
CC5E:B9 93 CC   PROMPTLOOP LDA PROMPTBL,Y
CC61:85 27              STA  CHARACTER
CC63:98                 TYA
CC64:48                 PHA
CC65:20 A3 CC           JSR  SCREENOUT1 ;ALWAYS SEND TO SCREEN
CC68:68                 PLA
CC69:A8                 TAY
CC6A:88                 DEY
CC6B:10 F1              BPL  PROMPTLOOP
CC6D:           *
```

```
CC6D:A9 01                LDA  #1         ;START OUT IN COMMAND STATE 1
CC6F:20 7B CE             JSR  SETOSTATE
CC72:            *
CC72:20 34 CC    GETCMD   JSR  CKKBD1     ;WAIT FOR KEYBOARD CHARACTER
CC75:10 FB                BPL  GETCMD
CC77:C9 88                CMP  #$88       ;BACKSPACE?
CC79:F0 E1                BEQ  KBDESC     ;IF SO, THEN START OVER
CC7B:85 27                STA  CHARACTER
CC7D:            *
CC7D:20 A3 CC             JSR  SCREENOUT1
CC80:20 1A CB             JSR  CMDSEQCK   ;PUMP THRU CMD INTERPRETER
CC83:            *
CC83:BD B8 04             LDA  STATEFLG,X ;ARE WE DONE?
CC86:29 07                AND  #$07
CC88:D0 E8                BNE  GETCMD     ;IF NOT, GO AGAIN
CC8A:            *
CC8A:A9 8D                LDA  #$8D       ;FORCE BACK A CARRIAGE RETURN
CC8C:85 27                STA  CHARACTER
CC8E:2C 58 FF             BIT  IORTS      ;INDICATE THAT A CMD SEQ HAS OCCURRED
CC91:38          GETKBDONE SEC            ;INDICATE SUCCESS
CC92:60                   RTS
CC93:            *
CC93:            *
CC93:BA C3 D3    PROMPTBL ASC ":CSS     ELPPA"
CC96:D3 A0 C5
CC99:CC D0 D0
CC9C:C1
CC9D:8D                   DFB  $8D
CC9E:            *
CC9E:            *********************************************************
CC9E:            * ROUTINE TO PRINT A CHARACTER ON THE CURRENT DISPLAY *
CC9E:            *********************************************************
CC9E:BD 38 07    SCREENOUT LDA MISCFLG,X
CCA1:10 13                BPL  NOOUT      ;IF SCREEN DISABLED
CCA3:            *
CCA3:BD 38 07    SCREENOUT1 LDA MISCFLG,X ;ENTRY AFTER ECHO CHECK
CCA6:29 02                AND  #$02       ;IF IT ISN'T CIC MODE,
CCA8:F0 0D                BEQ  ASCREEN    ;ALWAYS USE THE APPLE SCREEN
CCAA:BD B8 04             LDA  STATEFLG,X ;CURRENT SCREEN = APPLE SCREEN?
CCAD:29 38                AND  #$38
CCAF:F0 06                BEQ  ASCREEN    ;SLOT 0= APPLE SCREEN
CCB1:            *
CCB1:8A                   TXA              ;JUMP TO CN00 SPACE
CCB2:48                   PHA
CCB3:A9 AF                LDA  #>SENDCD-1  ; TO VECTOR TO THE PERIPHERAL
CCB5:48                   PHA              ; IN THE CHAIN SLOT
CCB6:60          NOOUT    RTS
CCB7:            *
CCB7:            * APPLE 40-COL SCREEN DRIVER
CCB7:            *
CCB7:20 DF CC    ASCREEN JSR   GETXLATE   ;GET THE TRANSLATE OPTIONS
CCBA:09 80                ORA  #$80       ;SET HIGH BIT OF CHAR
CCBC:C9 E0                CMP  #$E0       ;LOWERCASE?
CCBE:90 06                BCC  TESTLETTER
CCC0:59 D3 CC             EOR  LCMASK,Y   ;DO LOWERCASE TRIP
CCC3:4C F6 FD    TOSCREEN JMP  VIDOUT     ;ALL REGS ARE PRESERVED
CCC6:            *
CCC6:            * IF UPPERCASE, WE ONLY MAP LETTERS
```

```
CCC6:            *
CCC6:C9 C1       TESTLETTER CMP #$C1     ;<A?
CCC8:90 F9                  BCC  TOSCREEN
CCCA:C9 DB                  CMP  #$DB       ;>Z?
CCCC:B0 F5                  BCS  TOSCREEN
CCCE:59 D7 CC               EOR  UCMASK,Y
CCD1:90 F0                  BCC  TOSCREEN   ;<ALWAYS>
CCD3:            *
CCD3:            * MASKS FOR CASE TRANSLATION
CCD3:20 00 E0    LCMASK     DFB  $20,$00,$E0,$20
CCD6:20
CCD7:00 00 00    UCMASK     DFB  $00,$00,$00,$C0
CCDA:C0
CCDB:00 00 E0    REVMASK    DFB  $00,$00,$E0,$C0
CCDE:C0
CCDF:            *
CCDF:BD B8 03    GETXLATE LDA DELAYFLG,X ;TRANSLATE OPTIONS IN B6-B7
CCE2:2A                     ROL  A
CCE3:2A                     ROL  A
CCE4:2A                     ROL  A
CCE5:29 03                  AND  #$03
CCE7:A8                     TAY
CCE8:A5 27                  LDA  CHARACTER
CCEA:60                     RTS
CCEB:            *
```

(listings continued on next page)

```
CCEB:          138        CHN  SSC.CMD
CCEB:            1 *********************************
CCEB:            2 *                               *
CCEB:            3 * APPLE II SSC FIRMWARE         *
CCEB:            4 *                               *
CCEB:            5 *   BY LARRY KENYON             *
CCEB:            6 *                               *
CCEB:            7 *    -JANUARY 1981-             **************
CCEB:            8 *                                            *
CCEB:            9 * (C) COPYRIGHT 1981 BY APPLE COMPUTER, INC. *
CCEB:           10 *                                            *
CCEB:           11 **********************************************
CCEB:           12 *                               *
CCEB:           13 * SSC COMMAND PROCESSOR         *
CCEB:           14 *                               *
CCEB:           15 *********************************
CCEB:           16 ****************************************************
CCEB:           17 * COMMAND TABLE (USED BY COMMAND PROCESSER ROUTINE *
CCEB:           18 ****************************************************
CCEB:42         19 CMDTBL  DFB  $42        ;B(REAK)
CCEC:67         20         DFB  $67        ;CIC     PAS  NS=7
CCED:C0         21         DFB  >BREAKCMD-1
CCEE:54         22         DFB  $54        ;T(ERMINAL)
CCEF:47         23         DFB  $47        ;CIC          NS=7
CCF0:A6         24         DFB  >TERMCMD-1
CCF1:43         25         DFB  $43        ;C(R GENERATE)
CCF2:87         26         DFB  $87        ;    PPC      NS=7
CCF3:A6         27         DFB  >TERMCMD-1
CCF4:51         28         DFB  $51        ;Q(UIT)
CCF5:47         29         DFB  $47        ;CIC          NS=7
CCF6:B8         30         DFB  >QUITCMD-1
CCF7:52         31         DFB  $52        ;R(ESET)
CCF8:C7         32         DFB  $C7        ;CIC PPC      NS=7
CCF9:AC         33         DFB  >RESETCMD-1
CCFA:5A         34         DFB  $5A        ;Z COMMAND
CCFB:E7         35         DFB  $E7        ;CIC PPC PAS  NS=7
CCFC:F3         36         DFB  >ZCMD-1
CCFD:49         37         DFB  $49        ;I COMMAND
CCFE:90         38         DFB  $90        ;    PPC      NS=0
CCFF:D3         39         DFB  >ICMD-1
CD00:4B         40         DFB  $4B        ;K COMMAND
CD01:90         41         DFB  $90        ;    PPC      NS=0
CD02:DF         42         DFB  >KCMD-1
CD03:           43 *
CD03:45         44         DFB  $45        ;E(CHO)
CD04:43         45         DFB  $43        ;CIC          NS=3
CD05:80         46         DFB  $80
CD06:46         47         DFB  $46        ;F(ROMKYBD)
CD07:E3         48         DFB  $E3        ;CIC PPC PAS  NS=3
CD08:04         49         DFB  $04
CD09:4C         50         DFB  $4C        ;L(F GENERATE)
CD0A:E3         51         DFB  $E3        ;CIC PPC PAS  NS=3
CD0B:01         52         DFB  $01
CD0C:58         53         DFB  $58        ;X(OFF)
CD0D:E3         54         DFB  $E3        ;CIC PPC PAS  NS=3
CD0E:08         55         DFB  $08
CD0F:54         56         DFB  $54        ;T(ABBING)
CD10:83         57         DFB  $83        ;    PPC      NS=3
```

```
CD11:40                 DFB  $40
CD12:53                 DFB  $53         ;S(HIFTING)
CD13:43                 DFB  $43         ;CIC            NS=3
CD14:40                 DFB  $40
CD15:4D                 DFB  $4D         ;M(UNCH LF)
CD16:E3                 DFB  $E3         ;CIC PPC PAS    NS=3
CD17:20                 DFB  $20
CD18:          *
CD18:00                 DFB  $0C         ;END OF FIRST PART MARKER
CD19:          *
CD19:42        CMDTBL1  DFB  $42         ;B(AUD)
CD1A:F6                 DFB  $F6         ;CIC PPC PAS    NS=6
CD1B:7C                 DFB  >BAUDCMD-1
CD1C:50                 DFB  $50         ;P(ARITY)
CD1D:F6                 DFB  $F6         ;CIC PPC PAS    NS=6
CD1E:9A                 DFB  >PARITYCMD-1
CD1F:44                 DFB  $44         ;D(ATA)
CD20:F6                 DFB  $F6         ;CIC PPC PAS    NS=6
CD21:9B                 DFB  >DATACMD-1
CD22:46                 DFB  $46         ;F(F DELAY)
CD23:F6                 DFB  $F6         ;CIC PPC PAS    NS=6
CD24:46                 DFB  >FFCMD-1
CD25:4C                 DFB  $4C         ;L(F DELAY)
CD26:F6                 DFB  $F6         ;CIC PPC PAS    NS=6
CD27:40                 DFB  >LFCMD-1
CD28:43                 DFB  $43         ;C(R DELAY)
CD29:F6                 DFB  $F6         ;CIC PPC PAS    NS=6
CD2A:3A                 DFB  >CRCMD-1
CD2B:54                 DFB  $54         ;T(RANSLATE)
CD2C:D6                 DFB  $D6         ;CIC PPC        NS=6
CD2D:34                 DFB  >TRANCMD-1
CD2E:4E                 DFB  $4E         ;N COMMAND
CD2F:90                 DFB  $90         ;    PPC        NS=0
CD30:E8                 DFB  >NCMD-1
CD31:53                 DFB  $53         ;S(CREENSLOT)
CD32:56                 DFB  $56         ;CIC            NS=6
CD33:60                 DFB  >SSLOTCMD-1
CD34:          *
CD34:00                 DFB  $00         ;END OF TABLE MARKER
CD35:          *
CD35:          *********************
CD35:          * COMMAND ROUTINES   *
CD35:          * (CALLED BY PARSER) *
CD35:          * (MUST START IN     *
CD35:          *  PAGE $CD . . . )  *
CD35:          *********************
CD35:A9 3F     TRANCMD  LDA  #$3F        ;SET SCREEN TRANSLATE OPTIONS
CD37:A0 07              LDY  #$7
CD39:D0 10              BNE  DELAYSET    ;<ALWAYS>
CD3B:A9 CF     CRCMD    LDA  #$CF        ;SET CR DELAY
CD3D:A0 05              LDY  #$5
CD3F:D0 0A              BNE  DELAYSET    ;<ALWAYS>
CD41:          *
CD41:A9 F3     LFCMD    LDA  #$F3        ;SET LF DELAY
CD43:A0 03              LDY  #$3
CD45:D0 04              BNE  DELAYSET    ;<ALWAYS>
CD47:          *
CD47:A9 FC     FFCMD    LDA  #$FC        ;SET FF DELAY
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```
CD49:A0 01                LDY  #$1
CD4B:3D B8 03    DELAYSET AND  DELAYFLG,X ;DON'T DISTURB THE OTHER FLAGS
CD4E:85 2A                STA  ZPTMP1
CD50:BD 38 04             LDA  PARAMETER,X
CD53:29 03                AND  #$03       ;JUST USE TWO BITS
CD55:18                   CLC
CD56:6A                   ROR  A          ;ONCE FOR FUN
CD57:2A          ROTATE   ROL  A          ;CHANGE DIRECTIONS
CD58:88                   DEY
CD59:D0 FC                BNE  ROTATE     ;PREPARE IT TO OR INTO THE FLAGS
CD5B:            *
CD5B:05 2A                ORA  ZPTMP1
CD5D:9D B8 03             STA  DELAYFLG,X
CD60:60                   RTS
CD61:            *
CD61:29 07       SSLOTCMD AND  #$7        ;SET SLOT COMMAND
CD63:0A                   ASL  A
CD64:0A                   ASL  A
CD65:0A                   ASL  A
CD66:85 2A                STA  ZPTMP1
CD68:0A                   ASL  A
CD69:C5 26                CMP  SLOT16     ;MAKE SURE WE DON'T SET IT
CD6B:F0 0F                BEQ  SSLOTCMD1  ; TO OUR OWN SLOT
CD6D:BD B8 04             LDA  STATEFLG,X
CD70:29 C7                AND  #$C7       ;PUT NEW SLOT NUMBER IN BITS 3-5
CD72:05 2A                ORA  ZPTMP1     ; OF CMDBYTE,X
CD74:9D B8 04             STA  STATEFLG,X
CD77:A9 00                LDA  #0         ;STORE ZERO INTO
CD79:9D 38 06             STA  CHNBYTE,X ;SLOT OFFSET (SET TO CN00 ENTRY)
CD7C:60          SSLOTCMD1 RTS
CD7D:            *
CD7D:29 0F       BAUDCMD  AND  #$0F       ;SET NEW BAUD RATE
CD7F:D0 07                BNE  BAUDCMD2
CD81:B9 81 C0    BAUDCMD1 LDA  DIPSW1,Y   ;ZERO PARM = RELOAD FROM SWITCHES
CD84:4A                   LSR  A
CD85:4A                   LSR  A
CD86:4A                   LSR  A
CD87:4A                   LSR  A
CD88:09 10       BAUDCMD2 ORA  #$10       ;SET INT. BAUD RATE GENERATOR
CD8A:85 2A                STA  ZPTMP1
CD8C:A9 E0                LDA  #$E0
CD8E:85 2B       CTLREGSET STA ZPTMP2
CD90:B9 8B C0             LDA  CTLREG,Y
CD93:25 2B                AND  ZPTMP2
CD95:05 2A                ORA  ZPTMP1
CD97:99 8B C0             STA  CTLREG,Y
CD9A:60                   RTS
CD9B:            *
CD9B:88          PARITYCMD DEY             ;TRICK: SO CTLREG,Y ACTUALLY
CD9C:            *                        ADDRESSES THE COMMAND REG
CD9C:            *
CD9C:0A          DATACMD  ASL  A          ;SET NEW # OF DATA BITS
CD9D:0A                   ASL  A
CD9E:0A                   ASL  A
CD9F:0A                   ASL  A
CDA0:0A                   ASL  A
CDA1:85 2A       DATACMD1 STA  ZPTMP1
CDA3:A9 1F                LDA  #$1F
```

```
CDA5:D0 E7                 BNE  CTLREGSET  ;<ALWAYS>
CDA7:             *
CDA7:1E B8 04     TERMCMD  ASL  STATEFLG,X ;SET TERMINAL MODE
CDAA:38                    SEC
CDAB:B0 10                 BCS  QCMD1      ;<ALWAYS>
CDAD:             *
CDAD:99 89 C0     RESETCMD STA  RESET,Y    ;DROP RTS, DTR
CDB0:20 93 FE              JSR  SETSCR     ;PR#0
CDB3:20 89 FE              JSR  SETKBD     ;IN#0
CDB6:AE F8 07              LDX  MSLOT
CDB9:1E B8 04     QUITCMD  ASL  STATEFLG,X ;CLEAR TERMINAL MODE
CDBC:18                    CLC
CDBD:7E B8 04     QCMD1    ROR  STATEFLG,X
CDC0:60                    RTS
CDC1:             *
CDC1:B9 8A C0     BREAKCMD LDA  CMDREG,Y   ;SEND BREAK SIGNAL
CDC4:48                    PHA              ; FOR 233 MILLISECONDS
CDC5:09 0C                 ORA  #$0C
CDC7:99 8A C0              STA  CMDREG,Y
CDCA:A9 E9                 LDA  #233       ;DELAY FOR 233 MICROSEC.
CDCC:20 C4 CA              JSR  WAITMS
CDCF:68                    PLA              ;RESTORE OLD COMMAND REG CONTENTS
CDD0:99 8A C0              STA  CMDREG,Y
CDD3:60                    RTS
CDD4:             *
CDD4:A9 28        ICMD     LDA  #$28
CDD6:9D 38 06              STA  PWDBYTE,X  ;SET PRINTER WIDTH TO 40
CDD9:A9 80                 LDA  #$80
CDDB:1D 38 07              ORA  MISCFLG,X  ;SET SCREEN ECHO
CDDE:D0 05                 BNE  KCMD2      ;<ALWAYS>
CDE0:             *
CDE0:A9 FE        KCMD     LDA  #$FE       ;RESET THE LF GENERATE FLAG
CDE2:3D 38 07     KCMD1    AND  MISCFLG,X
CDE5:9D 38 07     KCMD2    STA  MISCFLG,X
CDE8:60                    RTS
CDE9:             *
CDE9:C9 28        NCMD     CMP  #40        ;>=40?
CDEB:90 0E                 BCC  ZCMDRTS    ;IF NOT, JUST EXIT
CDED:9D 38 06              STA  PWDBYTE,X  ;SET NEW PRINTER WIDTH
CDF0:A9 3F                 LDA  #$3F       ;DISABLE SCREEN, SET LISTING MODE
CDF2:D0 EE                 BNE  KCMD1      ;<ALWAYS>
CDF4:             *
CDF4:1E 38 05     ZCMD     ASL  CMDBYTE,X  ;DISABLE COMMAND RECOGNITION
CDF7:38                    SEC
CDF8:7E 38 05              ROR  CMDBYTE,X
CDFB:60           ZCMDRTS  RTS
CDFC:             *
CDFC:             *************************************
CDFC:             * VECTOR ACCORDING TO COMMAND STATE *
CDFC:             *************************************
CDFC:A8           CMDPROC  TAY             ;A-REG=COMMAND STATE
CDFD:A5 27                 LDA  CHARACTER
CDFF:29 7F                 AND  #$7F
CE01:             *
CE01:C9 20                 CMP  #$20       ;SKIP SPACES FOR ALL MODES
CE03:D0 09                 BNE  CMDPROC2
CE05:C0 03                 CPY  #$3        ;EXCEPT MODE 3
CE07:F0 01                 BEQ  CMDPROC1
```

```
CE09:60                 RTS
CE0A:A9 04    CMDPROC1  LDA #$4
CE0C:D0 6D              BNE SETOSTATE ;<ALWAYS>
CE0E:         *
CE0E:C9 0D    CMDPROC2  CMP #$0D      ;CARRIAGE RETURN?
CE10:D0 12              BNE CMDPROC4  ;
CE12:20 79 CE           JSR ZEROSTATE ;ABORT FOR STATES 0-5, EXIT FOR 6,7
CE15:C0 07              CPY #$07      ;IN STATE 7 WE VECTOR TO THE PROC
CE17:F0 01              BEQ CMDPROC3  ;
CE19:60                 RTS            ;OTHERWISE, JUST EXIT
CE1A:         *
CE1A:A9 CD    CMDPROC3  LDA #$CD      ;ALL PROCS MUST START IN PAGE $CD
CE1C:48                 PHA
CE1D:BD 38 04           LDA PARAMETER,X
CE20:48                 PHA
CE21:A4 26              LDY SLOT16    ;NEEDED BY BREAK CMD
CE23:60                 RTS
CE24:         *
CE24:85 35    CMDPROC4  STA ZPTEMP
CE26:A9 CE              LDA #$CE      ;ALL ROUTINES MUST START
CE28:48                 PHA           ; IN PAGE $CE
CE29:B9 30 CE           LDA STATETBL,Y
CE2C:48                 PHA
CE2D:A5 35              LDA ZPTEMP
CE2F:60                 RTS           ;RTS TO COMMAND PROCEDURE
CE30:         *
CE30:         * NOW THE STATE ROUTINES
CE30:         *
CE30:         ***********************
CE30:         *  STATE BRANCH TABLE *
CE30:         ***********************
CE30:A7       STATETBL  DFB >STATERR-1 ;BAD STATE
CE31:37                 DFB >CSTATE1-1 ;<CMD> SEEN
CE32:61                 DFB >CSTATE2-1 ;ACCUMULATE PARAMETER
CE33:89                 DFB >CDONE-1   ;SKIP UNTIL SPACE
CE34:8A                 DFB >CSTATE4-1 ;E/D SOMETHING
CE35:A7                 DFB >STATERR-1 ;ILLEGAL STATE
CE36:89                 DFB >CDONE-1   ;SKIP UNTIL CR
CE37:89                 DFB >CDONE-1   ;SKIP UNTIL CR THEN DO CMD
CE38:         *******************
CE38:         * COMMAND STATE 1 *
CE38:         *******************
CE38:DD 38 05 CSTATE1   CMP CMDBYTE,X ;IS IT <CMD>?
CE3B:D0 06              BNE CSTATE1A
CE3D:DE B8 04           DEC STATEFLG,X ;SET STATE BACK TO ZERO
CE40:4C 02 CC           JMP ACIAOUT   ;OUTPUT <CMD> IF SO
CE43:         *
CE43:C9 30    CSTATE1A  CMP #$30      ;>=0?
CE45:90 0D              BCC CSTATE1B
CE47:C9 3A              CMP #$3A      ;<=9?
CE49:B0 09              BCS CSTATE1B
CE4B:29 0F              AND #$0F      ;IT'S A NUMBER
CE4D:9D 38 04           STA PARAMETER,X
CE50:A9 02              LDA #2
CE52:D0 27              BNE SETOSTATE ;<ALWAYS> SET MODE 2 AND RETURN
CE54:         *
CE54:C9 20    CSTATE1B  CMP #$20      ;IS IT A CONTROL CHAR?
CE56:B0 06              BCS CSTATE1C
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```
CE58:9D 38 05   290          STA  CMDBYTE,X ;SET NEW COMMAND CHARACTER
CE5B:4C 79 CE   291          JMP  ZEROSTATE ;RESET STATE TO ZERO
CE5E:           292 *
CE5E:A0 00      293 CSTATE1C LDY #0         ;USE COMMAND TABLE
CE60:F0 4D      294          BEQ  CMDSEARCH ;<ALWAYS>
CE62:           295 ****************************************
CE62:           296 * COMMAND STATE 2: ACCUMULATE PARAMETER *
CE62:           297 ****************************************
CE62:49 30      298 CSTATE2 EOR  #$30       ;CONVERT $30-$39 TO 0-9
CE64:C9 0A      299          CMP  #$A       ;0-9?
CE66:B0 0D      300          BCS  CSTATE2A
CE68:A0 0A      301          LDY  #$A       ;IT'S A NUMBER, SO ADD
CE6A:7D 38 04   302 ACCLOOP ADC  PARAMETER,X ; IT TO 10*PARAMETER
CE6D:88         303          DEY
CE6E:D0 FA      304          BNE  ACCLOOP
CE70:9D 38 04   305          STA  PARAMETER,X
CE73:F0 15      306          BEQ  CDONE     ;<ALWAYS>
CE75:           307 *
CE75:A0 2E      308 CSTATE2A LDY #CMDTBL1-CMDTBL ;USE COMMAND TABLE
CE77:D0 36      309          BNE  CMDSEARCH ;<ALWAYS>
CE79:           310 ********************
CE79:           311 * SET COMMAND STATE *
CE79:           312 ********************
CE79:A9 00      313 ZEROSTATE LDA #0
CE7B:85 2A      314 SETOSTATE STA ZPTMP1
CE7D:AE F8 07   315          LDX  MSLOT
CE80:BD B8 04   316          LDA  STATEFLG,X
CE83:29 F8      317          AND  #$F8
CE85:05 2A      318          ORA  ZPTMP1
CE87:9D B8 04   319          STA  STATEFLG,X
CE8A:60         320 CDONE    RTS
CE8B:           321 ************************
CE8B:           322 * COMMAND STATE 4 (E/D) *
CE8B:           323 ************************
CE8B:A8         324 CSTATE4 TAY             ;E/D -> Y-REG
CE8C:BD 38 04   325          LDA  PARAMETER,X
CE8F:C0 44      326          CPY  #$44      ;D(ISABLE)?
CE91:F0 09      327          BEQ  CSTATE4A
CE93:C0 45      328          CPY  #$45      ;E(NABLE)?
CE95:D0 11      329          BNE  STATERR   ;IF NOT, IGNORE THIS COMMAND
CE97:1D 38 07   330          ORA  MISCFLG,X ;SET FLAG
CE9A:D0 05      331          BNE  CSTATE4B  ;<ALWAYS>
CE9C:49 FF      332 CSTATE4A EOR #$FF       ;INVERT FOR DISABLE
CE9E:3D 38 07   333          AND  MISCFLG,X ;RESET FLAG
CEA1:9D 38 07   334 CSTATE4B STA MISCFLG,X
CEA4:           335 ********************
CEA4:           336 * ESCAPE TO STATE 6 *
CEA4:           337 ********************
CEA4:A9 06      338 SETSTATE6 LDA #6
CEA6:D0 D3      339          BNE  SETOSTATE ;<ALWAYS>
CEA8:A9 20      340 STATERR LDA  #32        ;CODE FOR BAD COMMAND
CEAA:9D B8 05   341          STA  STSBYTE,X
CEAD:D0 F5      342          BNE  SETSTATE6 ;<ALWAYS>
CEAF:           343 ********************************
CEAF:           344 * TABLE DRIVEN COMMAND PROCESSOR *
CEAF:           345 ********************************
CEAF:B9 EB CC   346 CMDSEARCH LDA CMDTBL,Y ;GET CANDIDATE CHARACTER
CEB2:F0 F4      347          BEQ  STATERR   ;A ZERO MARKS THE END OF A SUBTABLE
```

```
CEB4:C5 35      348          CMP  ZPTEMP    ;MATCH?
CEB6:F0 05      349          BEQ  CMDMATCH
CEB8:C8         350          INY
CEB9:C8         351 CMDSEARCH1 INY          ;REENTRY FOR WRONG MODES
CEBA:C8         352          INY            ;ENTRY LENGTH = 3
CEBB:D0 F2      353          BNE  CMDSEARCH ;<ALWAYS>
CEBD:           354 *
CEBD:C8         355 CMDMATCH INY
CEBE:B9 EB CC   356          LDA  CMDTBL,Y
CEC1:85 2A      357          STA  ZPTMP1
CEC3:29 20      358          AND  #$20      ;CHECK PASCAL ENABLE
CEC5:D0 07      359          BNE  CMDMATCH1 ;IT'S ON SO DONT CHECK P-BIT
CEC7:BD 38 07   360          LDA  MISCFLG,X ;OFF SO MAKE SURE
CECA:29 10      361          AND  #$10      ;  THAT WE AREN'T IN PASCAL
CECC:D0 EB      362          BNE  CMDSEARCH1 ;BRANCH IF WE ARE
CECE:           363 *
CECE:BD 38 07   364 CMDMATCH1 LDA MISCFLG,X ;GET CIC/PPC BIT
CED1:4A         365          LSR  A         ;SHIFT CIC/PPC MODE BIT TO CARRY
CED2:4A         366          LSR  A
CED3:24 2A      367          BIT  ZPTMP1    ;PPC->N CIC->V
CED5:B0 04      368          BCS  CMDMATCH2 ;BRANCH IF CIC MODE
CED7:10 E0      369          BPL  CMDSEARCH1 ;NOT OK FOR PPC
CED9:30 02      370          BMI  CMDEXEC   ;AND OK
CEDB:50 DC      371 CMDMATCH2 BVC CMDSEARCH1 ;NOT OK FOR CIC
CEDD:           372 *
CEDD:A5 2A      373 CMDEXEC LDA  ZPTMP1     ;RETRIEVE TABLE MODE BYTE
CEDF:48         374          PHA
CEE0:29 07      375          AND  #$07
CEE2:20 7B CE   376          JSR  SETOSTATE ;SET NEXT STATE
CEE5:C8         377          INY
CEE6:68         378          PLA
CEE7:29 10      379          AND  #$10      ;
CEE9:D0 07      380          BNE  CMDEXEC1  ;IF BIT 4 IS SET, VECTOR TO ROUTINE
CEEB:B9 EB CC   381          LDA  CMDTBL,Y
CEEE:9D 38 04   382          STA  PARAMETER,X
CEF1:60         383          RTS
CEF2:           384 *
CEF2:A9 CD      385 CMDEXEC1 LDA #$CD       ;ROUTINES MUST BE IN PAGE $CD
CEF4:48         386          PHA
CEF5:B9 EB CC   387          LDA  CMDTBL,Y
CEF8:48         388          PHA
CEF9:A4 26      389          LDY  SLOT16
CEFB:BD 38 04   390          LDA  PARAMETER,X ;LOT OF ROUTINES NEED THIS
CEFE:60         391          RTS
CEFF:           392 *
CEFF:00         393          DFB  $00
```

```
SYMBOL TABLE    SORTED BY SYMBOL

   3C A1L            CE6A ACCLOOP        CC02 ACIAOUT       ?CB9C ACK
 C9C8 ADJRTS         C9B5 ADJUST         CB59 ANRTS          CCB7 ASCREEN
 C8B8 BASICEXIT        28 BASL          ?C93D BATCHIN        C9EF BATCHIO
?C941 BATCHOUT       CD7D BAUDCMD        CD81 BAUDCMD1       CD88 BAUDCMD2
 C711 BENTRY         C8EF BINACIA1       C8EA BINACIA        C8E5 BINEND1
 C8D0 BINEND         C745 BINIT1        ?C700 BINIT          C8CB BINKBD
 C8BF BINPUT         C77C BOUTPUT1       C767 BOUTPUT        C78B BOUTPUT2
 CDC1 BREAKCMD       06B8 BUFBYTE        CE8A CDONE            24 CH
   27 CHARACTER      CA1E CHECKTERM      0638 CHNBYTE        C8B5 CICEXIT
 C9EE CIEND          C9D1 CKINPUT        C9E5 CKINPUT1       C9EB CKINPUT2
 CC3D CKKBDXIT       CC2C CKKBD          CC34 CKKBD1         0538 CMDBYTE
 CEF2 CMDEXEC1       CEDD CMDEXEC        CECE CMDMATCH1      CEBD CMDMATCH
 CEDB CMDMATCH2      CE0A CMDPROC1       CE0E CMDPROC2       CE1A CMDPROC3
 CE24 CMDPROC4       CDFC CMDPROC        C08A CMDREG         CEAF CMDSEARCH
 CEB9 CMDSEARCH1     CB1A CMDSEQCK       CD19 CMDTBL1        CCEB CMDTBL
 06B8 COLBYTE        C917 COMMA          FDED COUT           CD3B CRCMD
 CE43 CSTATE1A       CE54 CSTATE1B       CE5E CSTATE1C       CE38 CSTATE1
 CE75 CSTATE2A       CE62 CSTATE2        CE9C CSTATE4A       CEA1 CSTATE4B
 CE8B CSTATE4          37 CSWH             36 CSWL           C08B CTLREG
 CD8E CTLREGSET      C9C9 CTRLTST        CDA1 DATACMD1       CD9C DATACMD
 C9C0 DECRCOL        03B8 DELAYFLG       CD4B DELAYSET       C081 DIPSW1
 C082 DIPSW2         CBFF DLYTBL         CB2E ESCCHECK       CB90 ETX
 CD47 FFCMD          C968 FORCECR        C754 FROMIN         C751 FROMOUT
 C8B4 GETCHAR1       C8AA GETCHAR        CC72 GETCMD         CC3E GETKBD
 CC44 GETKBD1        CC91 GETKBDONE      CCDF GETXLATE       0438 HANDSHKE
 CDD4 ICMD           C705 IENTRY         0200 INBUFF         C805 INIT1
 C827 INIT1A         C835 INIT2          C83C INIT2A         C83F INIT2B
 C857 INIT3          C864 INIT4          C872 INIT5         ?C879 INITACIA
 C882 INITACIA1      C88F INITACIA2      CB16 INPUT2         CAFF INPUT
 FF58 IORTS          C010 KBDSTRB        C000 KBD            CC5C KBDESC
 CDE2 KCMD1          CDE5 KCMD2          CDE0 KCMD             39 KSWH
   38 KSWL           CCD3 LCMASK         CD41 LFCMD          CBEA LFGEN
 0738 MISCFLG        CA0C MOVIN          C9FD MOVOUT         07F8 MSLOT
 CDE9 NCMD           CB58 NOCMD          CB19 NOINPUT1       CB18 NOINPUT
 CCB6 NOOUT          C75C NORMIO         C954 NOTAB1         C951 NOTAB
 FCBA NXTA1          C707 OENTRY         CBD9 OUTDLY1        CBE2 OUTDLYLP
 CB68 OUTPUT1        CB6B OUTPUT2        CB63 OUTPUT         CBC1 OUTPUT3
 CBFE OUTPUTEND     ?CB76 P8AOUT1        CBA6 P8AOUT2        CBA9 P8AOUT3
 CBBB P8AOUT4        0438 PARAMETER      CD9B PARITYCMD      C800 PASCALINIT
?C89E PASCALREAD1    C89B PASCALREAD     C9AA PASCALWRITE    C8A3 PASEXIT
 C99B PENTRY         C78E PINIT         ?C84D PREAD0         C794 PREAD
 CC93 PROMPTBL       CC5E PROMPTLOOP     C7A8 PSTATIN        C79A PSTATUS
 C7AB PSTATUS2       0638 PWDBYTE        C9A6 PWDTBL         C797 PWRITE
 CDBD QCMD1          CDB9 QUITCMD        C088 RDREG          C089 RESET
 CDAD RESETCMD       CC11 RESTORE        CC29 RESTOREND      C7EE RESTORHOOK
 CCDB REVMASK          4F RNDH             4E RNDL           CFFF ROMSOFF
 CD57 ROTATE         C7B2 SAVEHOOK       CC9E SCREENOUT      CCA3 SCREENOUT1
 C7B0 SENDCD         C998 SEREND2        C97A SEREND         C8FC SEROUT
 C996 SETCH          FE89 SETKBD         CE7B SETOSTATE      FE93 SETSCR
 CEA4 SETSTATE6        26 SLOT16         CAE9 SRIN1          CAEB SRIN2
 CAD2 SRIN           CAF4 SRIN3          CAF5 SROUT          CD7C SSLOTCMD1
 CD61 SSLOTCMD       0100 STACK          04B8 STATEFLG       CEA8 STATERR
 CE30 STATETBL       C089 STREG          05B8 STSBYTE        C934 TAB1
 C948 TAB2           C921 TABCHECK      ?C088 TDREG          CA55 TERMACIAIN
 CAAD TERMCAP1       CA9B TERMCAP        CDA7 TERMCMD       ?CA4C TERMEXIT
 CA82 TERMINC1       CA81 TERMINC        CA66 TERMKBDIN      CA87 TERMLETTER
 CAB1 TERMLOCK      ?CA23 TERMMODE       CA2B TERMNEXT       CA31 TERMNEXT1
 CA41 TERMNEXT2      CA47 TERMNEXT3     ?CA7D TERMNORM       CA54 TERMRTS
 CA93 TERMSEND       CA95 TERMSEND1      CCC6 TESTLETTER     CCC3 TOSCREEN
 CD35 TRANCMD        CAB9 TRANSLATE      CCD7 UCMASK         FDF6 VIDOUT
 CAC4 WAITMS         CAC6 WAITMS1        CB3C XOFFCK         CB5A XONWAIT
 CDFB ZCMDRTS        CDF4 ZCMD           CE79 ZEROSTATE        35 ZPTEMP
   2A ZPTMP1           2B ZPTMP2

SYMBOL TABLE    SORTED BY ADDRESS

   24 CH               26 SLOT16           27 CHARACTER        28 BASL
   2A ZPTMP1           2B ZPTMP2           35 ZPTEMP           36 CSWL
   37 CSWH             38 KSWL             39 KSWH             3C A1L
   4E RNDL             4F RNDH           0100 STACK          0200 INBUFF
 03B8 DELAYFLG       0438 HANDSHKE       0438 PARAMETER      04B8 STATEFLG
 0538 CMDBYTE       05B8 STSBYTE       0638 PWDBYTE       0638 CHNBYTE
 06B8 COLBYTE       06B8 BUFBYTE       0738 MISCFLG       07F8 MSLOT
 C000 KBD           C010 KBDSTRB       C081 DIPSW1        C082 DIPSW2
?C088 TDREG         C088 RDREG         C089 STREG         C089 RESET
 C08A CMDREG        C08B CTLREG       ?C700 BINIT         C705 IENTRY
 C707 OENTRY        C711 BENTRY        C745 BINIT1        C751 FROMOUT
 C754 FROMIN        C75C NORMIO        C767 BOUTPUT       C77C BOUTPUT1
 C78B BOUTPUT2      C78E PINIT         C794 PREAD         C797 PWRITE
 C79A PSTATUS       C7A8 PSTATIN       C7AB PSTATUS2      C7B0 SENDCD
 C7B2 SAVEHOOK      C7EE RESTORHOOK    C800 PASCALINIT    C805 INIT1
 C827 INIT1A        C835 INIT2         C83C INIT2A        C83F INIT2B
?C84D PREAD0        C857 INIT3         C864 INIT4         C872 INIT5
?C879 INITACIA      C882 INITACIA1     C88F INITACIA2     C89B PASCALREAD
?C89E PASCALREAD1   C8A3 PASEXIT       C8AA GETCHAR       C8B4 GETCHAR1
 C8B5 CICEXIT       C8B8 BASICEXIT     C8BF BINPUT        C8CB BINKBD
 C8D0 BINEND        C8E5 BINEND1       C8EA BINACIA       C8EF BINACIA1
 C8FC SEROUT        C917 COMMA         C921 TABCHECK      C934 TAB1
?C93D BATCHIN      ?C941 BATCHOUT      C948 TAB2          C951 NOTAB
 C954 NOTAB1        C968 FORCECR       C97A SEREND        C996 SETCH
 C998 SEREND2       C99B PENTRY        C9A6 PWDTBL        C9AA PASCALWRITE
 C9B5 ADJUST        C9C0 DECRCOL       C9C8 ADJRTS        C9C9 CTRLTST
 C9D1 CKINPUT       C9E5 CKINPUT1      C9EB CKINPUT2      C9EE CIEND
 C9EF BATCHIO       C9FD MOVOUT        CA0C MOVIN         CA1E CHECKTERM
?CA23 TERMMODE      CA2B TERMNEXT      CA31 TERMNEXT1     CA41 TERMNEXT2
 CA47 TERMNEXT3    ?CA4C TERMEXIT      CA54 TERMRTS       CA55 TERMACIAIN
 CA66 TERMKBDIN    ?CA7D TERMNORM      CA81 TERMINC       CA82 TERMINC1
 CA87 TERMLETTER    CA93 TERMSEND      CA95 TERMSEND1     CA9B TERMCAP
 CAAD TERMCAP1      CAB1 TERMLOCK      CAB9 TRANSLATE     CAC4 WAITMS
 CAC6 WAITMS1       CAD2 SRIN          CAE9 SRIN1         CAEB SRIN2
 CAF4 SRIN3         CAF5 SROUT         CAFF INPUT         CB16 INPUT2
 CB18 NOINPUT       CB19 NOINPUT1      CB1A CMDSEQCK      CB2E ESCCHECK
 CB3C XOFFCK        CB58 NOCMD         CB59 ANRTS         CB5A XONWAIT
 CB63 OUTPUT        CB68 OUTPUT1       CB6B OUTPUT2      ?CB76 P8AOUT1
 CB90 ETX          ?CB9C ACK           CBA6 P8AOUT2       CBA9 P8AOUT3
 CBBB P8AOUT4       CBC1 OUTPUT3       CBD9 OUTDLY1       CBE2 OUTDLYLP
 CBEA LFGEN         CBFE OUTPUTEND     CBFF DLYTBL        CC02 ACIAOUT
 CC11 RESTORE       CC29 RESTOREND     CC2C CKKBD         CC34 CKKBD1
 CC3D CKKBDXIT      CC3E GETKBD        CC44 GETKBD1       CC5C KBDESC
 CC5E PROMPTLOOP    CC72 GETCMD        CC91 GETKBDONE     CC93 PROMPTBL
 CC9E SCREENOUT     CCA3 SCREENOUT1    CCB6 NOOUT         CCB7 ASCREEN
 CCC3 TOSCREEN      CCC6 TESTLETTER    CCD3 LCMASK        CCD7 UCMASK
 CCDB REVMASK       CCDF GETXLATE      CCEB CMDTBL        CD19 CMDTBL1
 CD35 TRANCMD       CD3B CRCMD         CD41 LFCMD         CD47 FFCMD
 CD4B DELAYSET      CD57 ROTATE        CD61 SSLOTCMD      CD7C SSLOTCMD1
 CD7D BAUDCMD       CD81 BAUDCMD1      CD88 BAUDCMD2      CD8E CTLREGSET
 CD9B PARITYCMD     CD9C DATACMD       CDA1 DATACMD1      CDA7 TERMCMD
 CDAD RESETCMD      CDB9 QUITCMD       CDBD QCMD1         CDC1 BREAKCMD
 CDD4 ICMD          CDE0 KCMD          CDE2 KCMD1         CDE5 KCMD2
 CDE9 NCMD          CDF4 ZCMD          CDFB ZCMDRTS       CDFC CMDPROC
 CE0A CMDPROC1      CE0E CMDPROC2      CE1A CMDPROC3      CE24 CMDPROC4
 CE30 STATETBL      CE38 CSTATE1       CE43 CSTATE1A      CE54 CSTATE1B
 CE5E CSTATE1C      CE62 CSTATE2       CE6A ACCLOOP       CE75 CSTATE2A
 CE79 ZEROSTATE     CE7B SETOSTATE     CE8A CDONE         CE8B CSTATE4
 CE9C CSTATE4A      CEA1 CSTATE4B      CEA4 SETSTATE6     CEA8 STATERR
 CEAF CMDSEARCH     CEB9 CMDSEARCH1    CEBD CMDMATCH      CECE CMDMATCH1
 CEDB CMDMATCH2     CEDD CMDEXEC       CEF2 CMDEXEC1      CFFF ROMSOFF
 FCBA NXTA1         FDED COUT          FDF6 VIDOUT        FE89 SETKBD
 FE93 SETSCR        FF58 IORTS
```

## APPENDIX B

# APPLE INTERFACE CARD EMULATION

The SSC emulates both the P8 and the P8A versions of the Apple II Serial Interface Card (SIC), although the SSC is not completely POKE-compatible with either. In addition, the SSC supports several Apple II Communications Card and Parallel Card software commands.

## OLD SERIAL INTERFACE CARD EMULATION

The SSC replaces the P8 and P8A versions of the Apple II Serial Interface Card (SIC) and it has two switch-selectable modes to emulate them, as explained below. However, because of firmware space limitations, the SSC does not support all functions of the older interface cards, and various POKE locations are different. This section explains these functional differences.

It is best to use Printer Mode rather than one of the emulation modes, except under these circumstances:

- if you have extensive existent applications that use PEEKs and POKEs to modify SIC operating characteristics
- if you need SIC P8A mode's ETX/ACK (or other-character/ACK) handshaking capabilities

What the SSC does NOT support that the old SIC does:

- P8 SIC block moves
- baud rates other than the 15 listed in the various baud rate tables in this manual (ACIA hardware generates only those 15)
- data formats other than 5 - 8 data bits and 1, 1-1/2 or 2 stop bits (ACIA characteristic; other formats rarely used anyway)
- <ESC>U and <ESC>L commands for upper and lowercase (but SSC's Translate command offers more options; POKEs also available)
- current-loop operation

To run the SSC in emulation of the old Apple II Serial Interface Card (SIC), prepare and install the SSC the same way as for Printer Mode (Chapters 1 and 2), with the following exceptions:

- Set mode switches SW1-5 ON and SW1-6 OFF to emulate the old SIC with a P8 ROM.
- Set mode switches SW1-5 OFF and SW1-6 OFF to emulate the old SIC with a P8A ROM.
- Install the SSC in whatever slot the old SIC was installed in for the application involved.
- Follow the instructions given in the next sections if the application program did PEEKs and POKEs.

## P8 EMULATION POKES

Changing SIC parameters was done either by setting the seven switches located on the card, or by POKEing the SIC slot RAM locations where this configuration data was stored. BASIC programs that talked through the old SIC may be used with the new SSC; however, if the program POKEs at these slot RAM locations, those POKEs must be changed to be compatible with the SSC's use of the RAM. The P8 and P8A ROMs differ slightly in their use of these RAM locations. Tables B-1 and B-2 show the transformation for P8 mode; additional differences for P8A mode are noted in the following section. Other POKE possibilities are described in Appendix A.

In the tables, the letter s stands for the slot number (1-7) in which the SSC is installed; the other letters are used as variables whose values are noted in the table (sometimes further down).

There is no claim that making these changes is simple. In fact, whenever possible it is best to use Printer Mode and its software commands to change SSC operating variables.

Here is an example of how to use the tables: let's say that the SSC is in slot #3. You want: a baud rate of 110; data format of 5 data bits and 2 stop bits, even parity; line width of 40 with video on, no automatic <LF> after <CR>; no translation of lowercase to uppercase; and no 1/4-second delay after <CR>. The PEEKs and POKEs:

```
POKE 49339, 243   (49291 + 3*16; 3 + 240)
POKE 49338, 107   (49290 + 3*16; p = 107)
POKE 2043, 132    (plug in magic number)
POKE 1147, 64     (plug in magic number)
```

The same thing in Printer Mode with appropriate switch settings is:

```
SW1-1 to SW1-7: ON  ON  OFF OFF OFF ON  ON
SW2-1 to SW2-7: --  OFF ON  ON  OFF OFF OFF
```

Then to set 5 data and 2 stop bits, use <CTRL-I>7D<RETURN>; for even parity, use <CTRL-I>3P<RETURN>; to leave lowercase alone, use <CTRL-I>1T<RETURN>. You can use commands to change baud rate, etc.

| Selection | SSC switches and settings | PEEKs and POKES to use for | |
|---|---|---|---|
| | | P8 Serial Card | Super Serial Card |
| P8 Mode: | SW1-5 ON, SW1-6 OFF | | |
| P8A Mode: | SW1-5 OFF, SW1-6 OFF | | |
| Baud Rate: | SW1-1 to SW1-4 same as Printer Mode | POKE 1144+s,r<br>r = | POKE 49291+s*16,r<br>r = b + d; b = |
| 50 | | (not available) | 1 dec/$01 hex |
| 75 | | 0 dec/$00 hex | 2 dec/$02 hex |
| 110 | | 176 dec/$B0 hex | 3 dec/$03 hex |
| 135 | | 144 dec/$90 hex | 4 dec/$04 hex |
| 150 | | 128 dec/$80 hex | 5 dec/$05 hex |
| 300 | | 64 dec/$40 hex | 6 dec/$06 hex |
| 600 | | 32 dec/$20 hex | 7 dec/$07 hex |
| 1200 | | 16 dec/$10 hex | 8 dec/$08 hex |
| 1800 | | 11 dec/$0B hex | 9 dec/$09 hex |
| 2400 | | 8 dec/$08 hex | 10 dec/$0A hex |
| 3600 | | 5 dec/$05 hex | 11 dec/$0B hex |
| 4800 | | 4 dec/$04 hex | 12 dec/$0C hex |
| 7200 | | (not available) | 13 dec/$0D hex |
| 9600 | | 2 dec/$02 hex | 14 dec/$0E hex |
| 19200 | | 1 dec/$01 hex | 15 dec/$0F hex |
| Data Format: | | POKE 1912+s,r<br>POKE 1272+s,t | (to get r above, add d to b) d = |
| 8 data,1 stop | SW2-1 ON | r = 9; t = 1* | 16 dec/$10 hex |
| 7 data,1 stop | | r = 8; t = 1* | 48 dec/#30 hex |
| 6 data,1 stop | | r = 7; t = 1* | 80 dec/$50 hex |
| 5 data,1 stop | | r = 6; t = 1* | 112 dec/$70 hex |
| 8 data,2 stop | SW2-1 OFF | r = 9; t = 2* | 144 dec/$90 hex |
| 7 data,2 stop | | r = 8; t = 2* | 176 dec/$B0 hex |
| 6 data,2 stop | | r = 7; t = 2* | 208 dec/$D0 hex |
| 5 data,2 stop | | r = 6; t = 2* | 240 dec/$F0 hex |
| | | * add 1 if p = 1 or 0 | |
| Parity: | | POKE 1400+s,p | POKE 49290+s*16,p |
| none | | p = 2 | p = 11 ($0B hex) |
| odd | | p = 1 | p = 43 ($2B hex) |
| even | | p = 0 | p = 107 ($6B hex) |
| MARK | | (not available) | (not available) |
| SPACE | | (not available) | (not available) |

Table B-1. SIC Switch Settings, PEEKs and POKEs, Part I

| Selection | SSC switches and settings | PEEKs and POKES to use for | |
|---|---|---|---|
| | | P8 Serial Card | Super Serial Card |
| Line Width: | SW2-3 & SW2-4, same as Printer Mode | POKE 1784+s,r<br>r=1 to 255;<br>for no <CR>,r=0 | POKE 1784+s,r<br>r=40 to 255; for no <CR>, PEEK 1400+s, POKE 1400+s, (old value + 128) |
| Video/<br>Generate <LF>/<br>Translate/<br><CR> Delay: | SW2-3 & SW2-4<br>SW2-5<br>(no switch)<br>SW2-2<br><br>(all switches same as in Printer Mode) | V = Video on?<br>G = Gen. <LF>?<br>T = LC to UC?<br>D = Dly 1/4 s?<br>POKE 2040+s,r<br>r=<br>dec hex V G T D<br>4 $04 Y N Y Y<br>5 $05 Y Y Y Y<br>36 $24 Y N N Y<br>37 $25 Y Y N Y<br>68 $44 Y N Y N<br>69 $45 Y Y Y N<br>100 $64 Y N N N<br>101 $65 Y Y N N<br>132 $84 N N Y Y<br>133 $85 N Y Y Y<br>164 $A4 N N N Y<br>165 $A5 N Y N Y<br>196 $C4 N N Y N<br>197 $C5 N Y Y N<br>228 $E4 N N N N<br>229 $E5 N Y N N | V = Video on?<br>G = Gen. <LF>?<br>POKE 2040+s,r<br>r=<br>dec hex V G<br>4 $04 N N<br>5 $05 N Y<br>132 $84 Y N<br>133 $85 Y Y<br><br>T = LC to UC?<br>D = Dly 1/4 s?<br>POKE 1144+s,r<br>r =<br>dec hex T D<br>0 $00 Y N<br>16 $10 Y Y<br>64 $40 N N<br>80 $50 N Y |

Table B-2. SIC Switch Settings, PEEKs and POKEs, Part II

## P8A EMULATION POKES

The P8A ROM differs from the P8 ROM in several ways:

1) The <CR> delay switch now determines whether an ETX/ACK handshake is performed after each <CR> that is transmitted. The corresponding RAM bit was not the same as the P8 <CR> delay bit, but was kept in bit 2 of location 1400+s. For SSC emulation, the control is the same as the <CR> delay bit as noted above (in location 1144+s).

2) The number of stop bits was always 2; for SSC P8A mode this is configured via switch SW2-1 and can also be set via software by POKEing location 4929 as noted above.

3) The printer width information was kept in the same location that the P8 ROM kept the number of stop bits; the P8 printer width byte was zeroed to avoid automatic generation of carriage returns. The SSC P8A emulation code keeps the printer width information in the

same place as for P8 emulation and uses the high-order bit at location 1400+s to control automatic generation of carriage returns.

4) Lowercase input is enabled by default for the P8A ROM; in P8A emulation, however, it is enabled by the POKE shown in Table B-2.

5) In contrast to the P8 ROM, the P8A ROM and the SSC do not support batch moves.

6) The enquire character for the SIC P8A ROM was ETX (ASCII 3); for SSC P8A mode, this can be changed to another control character by a POKE to location 1400+s. For example, to change the enquire character to ENQ (ASCII 5), which is used by many RS-232 devices, use this POKE: POKE 1400+s,5. Note that this also disables the automatic generation of carriage returns. Actually, any character between 0 and 31 can be used, although only 3 and 5 are used much.

## OTHER EMULATION MODE DIFFERENCES

If your old programs, written to control one of the old Serial Interface Card ROMs, still don't work after you've followed all this handy advice, then read on.

The SSC always monitors the RS-232-C handshake lines to determine whether or not the device is ready to accept data. If your device fails to assert one of these lines, the SSC will wait patiently forever.

When the arrow on the jumper block is pointing toward TERMINAL, your device sees DCD and DSR asserted as soon as the SSC is initialized, and the SSC sees CTS whenever the device sends RTS. If the device does not assert both RTS and DTR, the SSC will assume it is not ready to receive data. This can be used as a hardware handshake to prevent buffer overflow at the device (e.g., when your printer runs out of paper it can stop asserting one of these lines and the SSC will wait while you put in more paper). If you do not connect these lines, the SSC will always treat them as if they were asserted.

The Serial Interface Card tied RTS to CTS, and DTR to DCD and DSR; if your RS-232 device depended upon this, you may want to make a special connector which does this.

Your device may have depended upon the half-duplex nature of the SIC. The ACIA on the SSC is able to send and receive at the same time and is always configured to do so.

The SIC was initialized each time it was called at location $Cs00 (for example, by a PR#s or IN#s). The SSC is only reintialized after the ACIA has been reset (either by resetting the Apple or by exiting from Printer or Communication Mode via a Reset command).

# OLD COMMUNICATIONS CARD COMMANDS

The SSC supports all the functions supported by the old Apple II Communications Interface Card (CIC), although the two ACIAs' registers are not the same on a bit-by-bit level. The SSC also supports the CIC commands: <CTRL-T>, <CTRL-R>, and <CTRL-S>.

## SWITCH TO TERMINAL MODE—⟨CTRL-T⟩

In Communication Mode, the SSC is initialized to recognize the remote-control command <CTRL-T> arriving in the stream of incoming data. This character causes the SSC to enter Terminal Mode (the same as the T(erminal command (Chapter 3). You can disable <CTRL-T> recognition by issuing an X(OFF D(isable command.

## BYPASS TERMINAL MODE—⟨CTRL-R⟩

When the SSC is in Terminal Mode and X(OFF E(nable (the default in this mode) is in effect, the SSC recognizes the remote control command <CTRL-R> arriving in the input data stream, and responds by bypassing (exiting from) Terminal Mode. This is the same as the Q(uit Terminal Mode command (Chapter 3).

## XOFF—⟨CTRL-S⟩

The SSC interprets <CTRL-S> as the ASCII XOFF character. When it receives <CTRL-S> from a remote device, it stops transmitting data until it receives an XON character from that device.

# PARALLEL CARD COMMANDS

The SSC is not hardware compatible with the Apple II Parallel Cards. However, for the sake of compatibility with software written for parallel interface applications, the SSC supports the following commands. You do not need to follow these commands with <RETURN>.

## LINE WIDTH n AND VIDEO OFF—⟨CTRL-I⟩⟨n⟩N

This command turns off the Apple II video screen and generates a <CR> after n characters (if automatic <CR> generation is enabled via the C command (Chapter 2); n can be any value from 40 through 255.

## LINE WIDTH 40 AND VIDEO ON—⟨CTRL-I⟩I

This command turns on the Apple II video screen and sets the line width to 40.

## DISABLE AUTOMATIC LINEFEED—⟨CTRL-I⟩K

This command has the same effect as L(inefeed D(isable (Chapter 2): it turns off automatic generation of <LF> after <CR>.

# APPENDIX C

# SPECIFICATIONS AND SCHEMATICS

This appendix contains the SSC specifications, connector pin assignments, jumper block wiring, and a schematic diagram. Use the schematic diagram with the Theory of Operation section in Chapter 4.

## SSC SPECIFICATIONS

| | |
|---|---|
| PHYSICAL CHARACTERISTICS | |
| Dimensions | 2-3/4" x 7" (68.8 mm x 177.8 mm) |
| Weight | 3 oz. (90 gm), approximately |
| Cables required | internal cable from 10-pin header on SSC to DB-25 connector on case of Apple II (supplied); shielded RS-232-C cable to external device (not supplied) |
| Controls | 2 blocks of 7 switches each, set by user before installation |
| Special Tools | none required |
| ENVIRONMENT | |
| Operating temperature | 40° F to 95° F (5° C to 35° C) |
| Storage temperature | -40° F to 122° F (-40° C to 50° C) |
| Operating relative humidity | 5% to 95% (noncondensing) |
| Storage relative humidity | 5% to 95% (noncondensing) |

SPECIAL CIRCUITS

| | |
|---|---|
| SY6551 | Asynchronous Communications Interface Adapter |
| 2316 | Read Only Memory (2,048 by 8 bits) with SSC firmware |
| | The SSC has the usual power supply bypassing capacitors |

APPLE II SLOT LOCATION

| | |
|---|---|
| BASIC programs | any slot except slot #0 |
| APPLESOFT programs | any slot except slot #0 |
| PASCAL programs | slot #1 for use with printer, etc.<br>slot #2 for use with modem<br>slot #3 for use with terminal |

SOFTWARE COMPATIBILITY

The SSC is compatible with the following languages and operating systems:

Integer BASIC
Applesoft BASIC
DOS 3.2
DOS 3.3
Pascal 1.0
Pascal 1.1
6502 Assembler

Under BASIC, input sent to the SSC at high baud rates may be lost, since the SSC can only buffer two characters at a time and BASIC may not be fast enough to read characters before they are overlaid.

In any software environment, characters may be lost when sent to the video screen in scrolling mode at greater than 300 baud. There are at least three solutions to this problem: lower the baud rate to 300 baud; reduce the scrolling window size (using 2 fewer lines already makes 1200 baud possible), or use an 80-column card with automatic hardware scrolling.

# CONNECTOR PIN ASSIGNMENTS

Table C-1 lists the signals assigned to the connector pins on the 10-pin header at location 7B on the SSC, and the corresponding pins on the DB-25 connector that you attach to the back of the Apple II case.

| 10-pin Header | DB-25 Connector | Signal name |
|---|---|---|
| 1 | 1 | Frame Ground |
| 2 | 2 | Transmit Data (TXD) |
| 3 | 3 | Receive Data (RXD) |
| 4 | 4 | Request To Send (RTS) |
| 5 | 5 | Clear To Send (CTS) |
| 6 | 6 | Data Set Ready (DSR) |
| 7 | 19 | Secondary Clear To Send (SCTS) |
| 8 | 7 | Signal Ground |
| 9 | 20 | Data Terminal Ready (DTR) |
| 10 | 8 | Data Carrier Detect (DCD) |

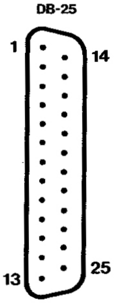


Table C-1. Connector Pin Assignments

# JUMPER BLOCK WIRING

Table C-2 lists the signals that the jumper block connects to the SSC when the arrow points toward the word MODEM and when it points toward the word TERMINAL. In the latter case, the jumper block acts as a modem eliminator.

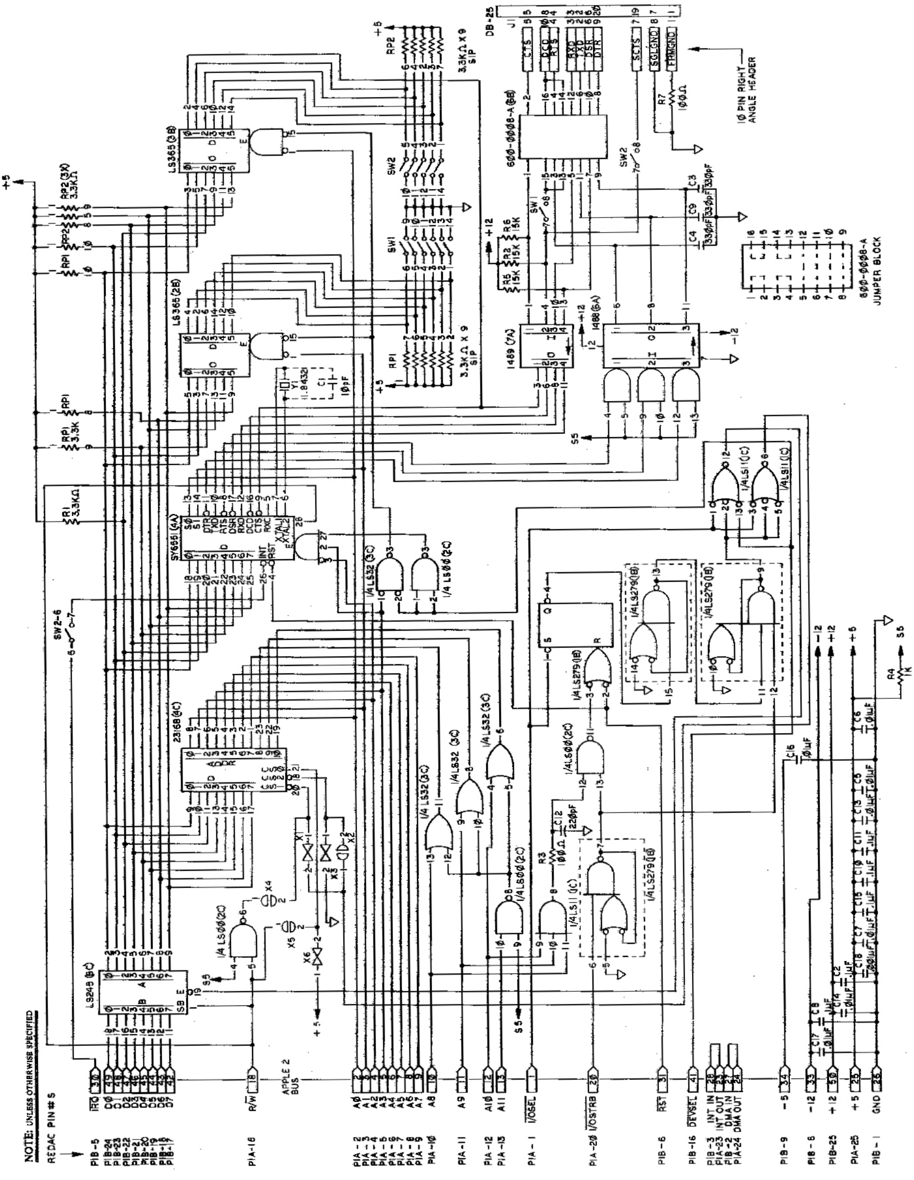
Note that all RS-232-C signals on the SSC use negative-true logic; that is, they are true (asserted) at 0 volts and false at +5 volts.

| Signal at SSC | MODEM position (pin) | TERMINAL position (pin) |
|---|---|---|
| Transmit Data | Transmit Data (2) | Receive Data (3) |
| Receive Data | Receive Data (3) | Transmit Data (2) |
| Request To Send | Request To Send (4) | Data Carrier Detect (8) |
| Clear To Send | Clear To Send (5) | Data Carrier Detect (8) |
| Data Set Ready | Data Set Ready (6) | Data Terminal Ready (20) |
| Data Terminal Ready | Data Term. Ready (20) | Data Set Ready (6) |
| Data Carrier Detect | Data Carrier Detect (8) | Request To Send (4) |
| Data Carrier Detect | Data Carrier Detect (8) | Clear To Send (5)* |

*When SW1-7 is OFF and SW2-7 is ON, the jumper block in the TERMINAL position connects Data Carrier Detect on the SSC to Secondary Clear To Send on the DB-25 connector.

Table C-2. Jumper Block Wiring

# SCHEMATIC DIAGRAM



NOTE: UNLESS OTHERWISE SPECIFIED
REDAC PIN # S
APPLE 2 BUS
IRQ 30
D0 49
D1 48
D2 47
D3 46
D4 45
D5 44
D6 43
D7 42
R/W 18
A0 2
A1 3
A2 4
A3 5
A4 6
A5 7
A6 8
A7 9
A8 10
A9 11
A10 12
A11 13
I/OSEL 1
I/OSTRB 20
RST 31
DEVSEL 41
INT IN 28
INT OUT 23
DMA IN 27
DMA OUT 24
-5 34
-12 33
+12 50
+5 25
GND 26
LS245 (6C)
2316B (4C)
SY6551 (4A)
LS365 (2B)
LS365 (3B)
1/4 LS00 (2C)
1/4 LS32 (3C)
1/4LS11 (1C)
1/4LS279 (1B)
1489 (7A)
1488 (6A)
Y1 1.8432
C1 10pF
RP1 3.3KΩ X 9 SIP
RP2 3.3KΩ X 9 SIP
R1 3.3KΩ
R2 15K
R5 15K
R6 15K
R3 100Ω
R4 1K
R7 100Ω
C12 220pF
C3 330pF
C4 330pF
C9 330pF
SW1
SW2
SW2-6
600-0008-A (6B)
600-0008-A JUMPER BLOCK
DB-25 J1
CTS
DCD
RTS
RXD
TXD
DSR
DTR
SCTS
SIGLGND
FRMGND
10 PIN RIGHT ANGLE HEADER
+5
+12
-12

# APPENDIX D

# ASCII CODE TABLE

The table below shows the entire ASCII character set, and how to generate each character. Not all characters are available directly from the Apple II keyboard. However, in Terminal Mode (Chapter 3) you can generate all of the lowercase and special ASCII characters not accessible directly from the Apple II keyboard.

Here is how to interpret this table:

- The BINARY column has the 7-bit code for each ASCII character.
- The LOW DEC column gives the decimal equivalent of the 7-bit binary value. This value is the same if the binary code has 8 bits and the high-order bit is 0 (SPACE parity; Pascal).
- The LOW HEX column gives the corresponding hexadecimal value.
- The HI DEC column gives the decimal equivalent of the 7-bit binary value if a high-order bit equal to 1 is appended to it (MARK parity; BASIC); for example, 11001000 for the letter H.
- The HI HEX column gives the corresponding hexadecimal value.
- The ASCII CHAR column gives the ASCII character name.
- The INTERPRETATION column spells out the meaning of special symbols and abbreviations where necessary.
- The WHAT TO TYPE column indicates what keystrokes generate the ASCII character from the NORMAL (unaided) Apple II keyboard, and from the TERMINAL Mode (firmware assisted) keyboard. Characters not accessible are labeled "n/a." The numbers between columns refer to footnotes.
- Angle brackets enclose the names of single keys (like <ESC> for the ESC key), or enclose keystrokes involving more than one key (like <CTRL-SHIFT-M>, which means "hold down CTRL and SHIFT while pressing M.") But <ESC>9 means "type ESC, THEN type 9" because the 9 is outside the angle brackets.

To put the SSC in Terminal Mode, set SW1-5 and SW1-6 both ON; then use the T command or the remote-control <CTRL-T> command. When the SSC first enters Terminal Mode, the keyboard is locked in uppercase. Press <ESC> once for lowercase. This also prepares the SSC for the special <ESC>-plus-number keystrokes. Press <ESC> twice in a row to lock the keyboard in uppercase again.

| 7-BIT | LOW | LOW | HI | HI | ASCII | | WHAT TO TYPE | |
|---|---|---|---|---|---|---|---|---|
| BINARY | DEC | HEX | DEC | HEX | CHAR | INTERPRETATION | NORMAL | TERMINAL |
| 0000000 | 0 | 00 | 128 | 80 | NUL | Blank (null) | <CTRL-@> | |
| 0000001 | 1 | 01 | 129 | 81 | SOH | Start of Header | <CTRL-A> | 1 |
| 0000010 | 2 | 02 | 130 | 82 | STX | Start of Text | <CTRL-B> | |
| 0000011 | 3 | 03 | 131 | 83 | ETX | End of Text | <CTRL-C> | 2 |
| 0000100 | 4 | 04 | 132 | 84 | EOT | End of Transm. | <CTRL-D> | |
| 0000101 | 5 | 05 | 133 | 85 | ENQ | Enquiry | <CTRL-E> | 3 |
| 0000110 | 6 | 06 | 134 | 86 | ACK | Acknowledge | <CTRL-F> | 4 |
| 0000111 | 7 | 07 | 135 | 87 | BEL | Bell | <CTRL-G> | |
| 0001000 | 8 | 08 | 136 | 88 | BS | Backspace | <CTRL-H> | 5 |
| 0001001 | 9 | 09 | 137 | 89 | HT | Horizontal Tab | <CTRL-I> | 6 |
| 0001010 | 10 | 0A | 138 | 8A | LF | Linefeed | <CTRL-J> | |
| 0001011 | 11 | 0B | 139 | 8B | VT | Vertical Tab | <CTRL-K> | |
| 0001100 | 12 | 0C | 140 | 8C | FF | Form Feed | <CTRL-L> | |
| 0001101 | 13 | 0D | 141 | 8D | CR | Carriage Return | <CTRL-M> | 7 |
| 0001110 | 14 | 0E | 142 | 8E | SO | Shift Out | <CTRL-N> | |
| 0001111 | 15 | 0F | 143 | 8F | SI | Shift In | <CTRL-O> | |
| 0010000 | 16 | 10 | 144 | 90 | DLE | Data Link Escape | <CTRL-P> | |
| 0010001 | 17 | 11 | 145 | 91 | DC1 | Device Control 1 | <CTRL-Q> | 8 |
| 0010010 | 18 | 12 | 146 | 92 | DC2 | Device Control 2 | <CTRL-R> | 9 |
| 0010011 | 19 | 13 | 147 | 93 | DC3 | Device Control 3 | <CTRL-S> | 10 |
| 0010100 | 20 | 14 | 148 | 94 | DC4 | Device Control 4 | <CTRL-T> | 11 |
| 0010101 | 21 | 15 | 149 | 95 | NAK | Neg. Acknowledge | <CTRL-U> | 12 |
| 0010110 | 22 | 16 | 150 | 96 | SYN | Synchronization | <CTRL-V> | |
| 0010111 | 23 | 17 | 151 | 97 | ETB | End of Text Blk. | <CTRL-W> | |
| 0011000 | 24 | 18 | 152 | 98 | CAN | Cancel | <CTRL-X> | |
| 0011001 | 25 | 19 | 153 | 99 | EM | End of Medium | <CTRL-Y> | |
| 0011010 | 26 | 1A | 154 | 9A | SUB | Substitute | <CTRL-Z> | |
| 0011011 | 27 | 1B | 155 | 9B | ESC | Escape | <ESC> | 13 <ESC>0 |

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1. Normal command character in Communication Mode.
2. Used in ETX/ACK protocol (SIC P8A Emulation Mode).
3. Used in ENQ/ACK protocol (SIC P8A Emulation Mode).
4. Used in ETX/ACK or ENQ/ACK protocol (SIC P8A Emulation Mode).
5. Or use ← key.
6. Normal Command character in Printer Mode.
7. Or use <RETURN> key.
8. XON in XON/XOFF protocol (usually in Communication Mode).
9. Remote-control command to Exit from Terminal Mode.
10. XOFF in XON/XOFF protocol (usually in Communication Mode).
11. Remote-control command to Enter Terminal Mode.
12. Or use → key.
13. Use the ESC key to generate the Escape character with the normal Apple II keyboard. In Terminal Mode, use <ESC>0.

| 7-BIT | LOW | LOW | HI | HI | ASCII | | WHAT TO TYPE | |
|---|---|---|---|---|---|---|---|---|
| BINARY | DEC | HEX | DEC | HEX | CHAR | INTERPRETATION | NORMAL | TERMINAL |
| 0011100 | 28 | 1C | 156 | 9C | FS | File Separator | n/a | <ESC>1 |
| 0011101 | 29 | 1D | 157 | 9D | GS | Group Separator | <CTRL-SHIFT-M> | |
| 0011110 | 30 | 1E | 158 | 9E | RS | Record Separator | <CTRL-SHIFT-N> | |
| 0011111 | 31 | 1F | 159 | 9F | US | Unit Separator | n/a | <ESC>2 |
| 0100000 | 32 | 20 | 160 | A0 | SP | Space | spacebar | |
| 0100001 | 33 | 21 | 161 | A1 | ! | | ! | |
| 0100010 | 34 | 22 | 162 | A2 | " | | " | |
| 0100011 | 35 | 23 | 163 | A3 | # | | # | |
| 0100100 | 36 | 24 | 164 | A4 | $ | | $ | |
| 0100101 | 37 | 25 | 165 | A5 | % | | % | |
| 0100110 | 38 | 26 | 166 | A6 | & | | & | |
| 0100111 | 39 | 27 | 167 | A7 | ’ | Closing Quote | ’ | |
| 0101000 | 40 | 28 | 168 | A8 | ( | | ( | |
| 0101001 | 41 | 29 | 169 | A9 | ) | | ) | |
| 0101010 | 42 | 2A | 170 | AA | * | | * | |
| 0101011 | 43 | 2B | 171 | AB | + | | + | |
| 0101100 | 44 | 2C | 172 | AC | , | Comma | , | |
| 0101101 | 45 | 2D | 173 | AD | - | Hyphen | - | |
| 0101110 | 46 | 2E | 174 | AE | . | Period | . | |
| 0101111 | 47 | 2F | 175 | AF | / | | / | |
| 0110000 | 48 | 30 | 176 | B0 | 0 | | 0 | |
| 0110001 | 49 | 31 | 177 | B1 | 1 | | 1 | |
| 0110010 | 50 | 32 | 178 | B2 | 2 | | 2 | |
| 0110011 | 51 | 33 | 179 | B3 | 3 | | 3 | |
| 0110100 | 52 | 34 | 180 | B4 | 4 | | 4 | |
| 0110101 | 53 | 35 | 181 | B5 | 5 | | 5 | |
| 0110110 | 54 | 36 | 182 | B6 | 6 | | 6 | |
| 0110111 | 55 | 37 | 183 | B7 | 7 | | 7 | |
| 0111000 | 56 | 38 | 184 | B8 | 8 | | 8 | |
| 0111001 | 57 | 39 | 185 | B9 | 9 | | 9 | |
| 0111010 | 58 | 3A | 186 | BA | : | | : | |
| 0111011 | 59 | 3B | 187 | BB | ; | | ; | |
| 0111100 | 60 | 3C | 188 | BC | < | | < | |
| 0111101 | 61 | 3D | 189 | BD | = | | = | |
| 0111110 | 62 | 3E | 190 | BE | > | | > | |
| 0111111 | 63 | 3F | 191 | BF | ? | | ? | |
| 1000000 | 64 | 40 | 192 | C0 | @ | | @ | |
| 1000001 | 65 | 41 | 193 | C1 | A | | A | |
| 1000010 | 66 | 42 | 194 | C2 | B | | B | |
| 1000011 | 67 | 43 | 195 | C3 | C | | C | |
| 1000100 | 68 | 44 | 196 | C4 | D | | D | |
| 1000101 | 69 | 45 | 197 | C5 | E | | E | |
| 1000110 | 70 | 46 | 198 | C6 | F | | F | |
| 1000111 | 71 | 47 | 199 | C7 | G | | G | |
| 1001000 | 72 | 48 | 200 | C8 | H | | H | |
| 1001001 | 73 | 49 | 201 | C9 | I | | I | |
| 1001010 | 74 | 4A | 202 | CA | J | | J | |
| 1001011 | 75 | 4B | 203 | CB | K | | K | |
| 1001100 | 76 | 4C | 204 | CC | L | | L | |
| 1001101 | 77 | 4D | 205 | CD | M | | M | |
| 1001110 | 78 | 4E | 206 | CE | N | | N | |

| 7-BIT | LOW | LOW | HI | HI | ASCII | | WHAT TO TYPE | |
|---|---|---|---|---|---|---|---|---|
| BINARY | DEC | HEX | DEC | HEX | CHAR | INTERPRETATION | NORMAL | TERMINAL |
| 1001111 | 79 | 4F | 207 | CF | O | | O | |
| 1010000 | 80 | 50 | 208 | D0 | P | | P | |
| 1010001 | 81 | 51 | 209 | D1 | Q | | Q | |
| 1010010 | 82 | 52 | 210 | D2 | R | | R | |
| 1010011 | 83 | 53 | 211 | D3 | S | | S | |
| 1010100 | 84 | 54 | 212 | D4 | T | | T | |
| 1010101 | 85 | 55 | 213 | D5 | U | | U | |
| 1010110 | 86 | 56 | 214 | D6 | V | | V | |
| 1010111 | 87 | 57 | 215 | D7 | W | | W | |
| 1011000 | 88 | 58 | 216 | D8 | X | | X | |
| 1011001 | 89 | 59 | 217 | D9 | Y | | Y | |
| 1011010 | 90 | 5A | 218 | DA | Z | | Z | |
| 1011011 | 91 | 5B | 219 | DB | [ | Opening Bracket | n/a | <ESC>3 |
| 1011100 | 92 | 5C | 220 | DC | \ | Reverse Slant | n/a | <ESC>4 |
| 1011101 | 93 | 5D | 221 | DD | ] | Closing Bracket | <SHIFT-M> | |
| 1011110 | 94 | 5E | 222 | DE | ^ | Circumflex | ^ | |
| 1011111 | 95 | 5F | 223 | DF | _ | Underline | n/a | <ESC>5 |
| 1100000 | 96 | 60 | 224 | E0 | ` | Opening Quote | n/a | 15 |
| 1100001 | 97 | 61 | 225 | E1 | a | | n/a | a |
| 1100010 | 98 | 62 | 226 | E2 | b | | n/a | b |
| 1100011 | 99 | 63 | 227 | E3 | c | | n/a | c |
| 1100100 | 100 | 64 | 228 | E4 | d | | n/a | d |
| 1100101 | 101 | 65 | 229 | E5 | e | | n/a | e |
| 1100110 | 102 | 66 | 230 | E6 | f | | n/a | f |
| 1100111 | 103 | 67 | 231 | E7 | g | | n/a | g |
| 1101000 | 104 | 68 | 232 | E8 | h | | n/a | h |
| 1101001 | 105 | 69 | 233 | E9 | i | | n/a | i |
| 1101010 | 106 | 6A | 234 | EA | j | | n/a | j |
| 1101011 | 107 | 6B | 235 | EB | k | | n/a | k |
| 1101100 | 108 | 6C | 236 | EC | l | | n/a | l |
| 1101101 | 109 | 6D | 237 | ED | m | | n/a | m |
| 1101110 | 110 | 6E | 238 | EE | n | | n/a | n |
| 1101111 | 111 | 6F | 239 | EF | o | | n/a | o |
| 1110000 | 112 | 70 | 240 | F0 | p | | n/a | p |
| 1110001 | 113 | 71 | 241 | F1 | q | | n/a | q |
| 1110010 | 114 | 72 | 242 | F2 | r | | n/a | r |
| 1110011 | 115 | 73 | 243 | F3 | s | | n/a | s |
| 1110100 | 116 | 74 | 244 | F4 | t | | n/a | t |
| 1110101 | 117 | 75 | 245 | F5 | u | | n/a | u |
| 1110110 | 118 | 76 | 246 | F6 | v | | n/a | v |
| 1110111 | 119 | 77 | 247 | F7 | w | | n/a | w |
| 1111000 | 120 | 78 | 248 | F8 | x | | n/a | x |
| 1111001 | 121 | 79 | 249 | F9 | y | | n/a | y |
| 1111010 | 122 | 7A | 250 | FA | z | | n/a | z |
| 1111011 | 123 | 7B | 251 | FB | { | Opening Brace | n/a | <ESC>6 |
| 1111100 | 124 | 7C | 252 | FC | \| | Vertical Line | n/a | <ESC>7 |
| 1111101 | 125 | 7D | 253 | FD | } | Closing Brace | n/a | <ESC>8 |
| 1111110 | 126 | 7E | 254 | FE | ~ | Overline (Tilde) | n/a | <ESC>9 |
| 1111111 | 127 | 7F | 255 | FF | DEL | Delete/Rubout | n/a | <ESC>: |

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15. Use Closing Quote (39). For high value, use CHR$(96), etc.

# APPENDIX E

# TROUBLESHOOTING HINTS

This appendix contains two tables designed to help you diagnose problems that can occur when using the SSC to communicate with an RS-232-C device. The device can be a printer, or a plotter, or terminal, or another computer, or some other Data Terminal Equipment (DTE), and it can be connected either directly, or via a modem or some other Data Communication Equipment (DCE). Whenever two DTEs are connected together, there must be TWO modems (DCEs) or ONE modem eliminator (such as the jumper block when it points toward the word TERMINAL) between them.

When diagnosing problems, remember that there are many variables involved in the communications connection:

- the Apple II and its keyboard, screen, and software
- the SSC, the slot it is in, its switch settings (especially mode selection), its jumper block, cable, and software commands
- the external cable, with some number of wires (enough wires?) connected to pins (all the correct pins?) at each end
- possibly two modems connected by low-grade telephone lines, plus another cable from the remote modem to the remote device
- an RS-232-C device at the other end, with its own switch settings and needs (such as paper, ribbon, AC power...)

As you can see, making all these components work together correctly is no mean feat. If there are problems, the easiest way to resolve them is to start with very simple, sure communication between the Apple and the device. Once you have established basic communication (even if the characters are garbled), further troubleshooting becomes much easier. Be patient and methodical.

Trouble usually has characteristics visible on the Apple II screen (Table E-1), or at the device (Table E-2). If your troubleshooting efforts fail, consult your Apple dealer--but first record all the variables (as outlined above) and the symptoms you observed.

| Problem | Symptom | Possible Cause | Solution |
|---|---|---|---|
| no data transfer | no sign of any communication at all | cable wires not connected OK; jumper block facing wrong way | check all cable connections, then pin assignments; try reversing jumper block |
| characters garbled | jh2 3g%$Q | wrong baud rate | change SW1-1 TO SW1-4 or use <n>B command |
| | | wrong data format | change SW2-1 (and SW2-2 in Comm Mode) or use <n>D command to change format |
| | | other device is off, out of paper, etc., off-line | turn on device, remedy its problems, put it on-line |
| paper not advancing | one line of smudge | printer needs line feeds from SSC | turn SW2-5 ON or use L(inefeed E(nable command |
| printer is skipping lines | lines look<br><br>like this | printer and SSC both generating <LF> after <CR> | turn off SW2-5 in Printer Mode, or use L(inefeed D(isable command |
| missing characters | mssig caractrs | device buffer is overflowing | if device supports full RS-232-C handshaking, ensure all required cable wires are connected<br>if device supports only ETX/ACK, set SIC P8A Mode<br>if device supports XON/XOFF, set Printer Mode and use X(OFF E(nable cmd or set Comm Mode<br>if device supports none of these, set delays with <n>C, <n>L and <n>F cmds |
| device sticks at line's end going nuts | one long OK line, smudge at right end | device doesn't generate own <CR>, and isn't getting enough from Apple | use SIC P8 Mode and <n>N command, or Printer Mode and C command plus appropriate SW2-3 and SW2-4<br>have software send <CR> before right margin |

Table E-1. Problems Detected at the Device

| Problem | Symptom | Possible Cause | Solution |
|---|---|---|---|
| Apple has occasional bad times | it works one minute & not next | ACIA interrupting the Apple when DCD or DSR changes | make sure that interrupt switch SW2-6 is OFF |
| Apple not working | dead kybd and screen | SSC in slot #3 under Pascal | Pascal expects external terminal to run the show |
| Apple kybd seems off | keystrokes all lost | echo off; keyboard zapped; IN# not 0 | use E(cho E(nable cmd; unzap with POKE; IN#0 |
| screen seems off | nothing typed is displayed | device not echoing (half duplex) or ACIA not sending to screen | in Comm or Terminal Mode, use E(cho E(nable; in SIC or Printer Mode, use I command or SW2-3 & -4 ON |
| screen is seeing double | eevveerryy<br>tthhiinngg<br>ttwwiiccee | device & SSC both echoing to Apple (full duplex) | use E(cho D(isable cmd in Comm Mode or use <n>N cmd in Printer Mode |
| screen is spacing double | lines look<br><br>like this | device generating and sending <LF> after <CR> | use M(ask E(nable command to remove extra linefeeds |
| forced uppercase display | lowercase<br>beCOMES<br>UPPERCASE | Apple monitor changing letters in GETLINE routine | use <n>T command to allow lowercase to pass through (not possible in Pascal) |
| Apple misses some characters at the beginning of lines | pple<br>sses<br>ome<br>racters<br>t the<br>bgnning<br>lines | screen scrolling too slowly, or BASIC or Pascal program running too slowly, and so ACIA overruns | turn off screen (<n>N or SW2-3 & -4 in Prtr Mode); reduce scroll window; use assembly language or faster program routines; use lower baud rate (300 vs. 1200); use <n>C, <n>L or <n>F commands; in Comm Mode, chain (<n>S cmd) to 80-column card with its own scrolling hardware |

Table E-2. Problems Detected at the Apple

# APPENDIX F

# ERROR CODES

The SSC uses I/O scratchpad address $678+s (s is the number of the slot that the SSC is in) to record status after a read operation. The firmware calls this byte STSBYTE. Table F-1 lists the bit definitions of this byte:

$678+s Status Byte (STSBYTE)

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| 0 | 0 | Error | 0 | Car Lst | Overrun | Frm Err | Par Err |

| Bit | "1" Means | "0" Means |
|---|---|---|
| 0 | Parity Error occurred | No Parity Error occurred |
| 1 | Framing Error occurred | No Framing Error occurred |
| 2 | Overrun occurred | No Overrun occurred |
| 3 | Carrier lost | Carrier present |
| 5 | Error occurred | No error occurred |

Table F-1. STSBYTE Bit Definitions

The terms Parity Error, Framing Error and Overrun are defined in the Glossary.

Bits 0,1, and 2 are the same as the corresponding three bits of the ACIA Status Register (Appendix A). Bit 3 indicates whether or not the Data Carrier Detect (DCD; Chapter 4) signal went false at any time during the receive operation. Bit 5 is set if any of the other bits are set, as an overall error indicator. If bit 5 is the only bit set, an unrecognized command was detected. If all bits are 0, no error occurred.

In BASIC, you can check this status byte via a PEEK $678+s (s is the SSC slot), and reset it with a POKE command at the same location.

In Pascal, the IORESULT function returns the error code value.

Any character--including the carriage return at the end of a WRITELN statement--will cause posting of a new value in IORESULT.

Table F-2 shows the possible combinations of error bits correspond to these decimal error codes.

| BASIC PEEK $678+s or Pascal IORESULT | Carrier Lost | Overrun | Framing Error | Parity Error |
|---|---|---|---|---|
| 0 | | (no error) | | |
| 32 | | (illegal command) | | |
| 33 | no | no | no | yes |
| 34 | no | no | yes | no |
| 35 | no | no | yes | yes |
| 36 | no | yes | no | no |
| 37 | no | yes | no | yes |
| 38 | no | yes | yes | no |
| 39 | no | yes | yes | yes |
| 40 | yes | no | no | no |
| 41 | yes | no | no | yes |
| 42 | yes | no | yes | no |
| 43 | yes | no | yes | yes |
| 44 | yes | yes | no | no |
| 45 | yes | yes | no | yes |
| 46 | yes | yes | yes | no |
| 47 | yes | yes | yes | yes |

Table F-2. Error Codes and Bits

These error codes begin with the number 32 to avoid conflicting with previously defined and documented system error codes.

# GLOSSARY

To avoid lengthy or repetitive definitions, many terms used in one definition are themselves defined elsewhere in this glossary. Also for the sake of brevity, terms and expressions are spelled out, with their abbreviations immediately after them. In a glossary of this size, the reader will have little difficulty locating abbreviations.

ACK: An ASCII character (decimal 6; Appendix D) sent from a device to the Apple II in response to an ETX or ENQ character in SIC P8A Emulation Mode.

American Standard Code for Information Interchange (ASCII): A standard defining the codes to represent a 128-element character set (Appendix D) in a fixed way for devices of different manufacturers. It is the standard for digital communication over telephone lines.

Asserted: Made true (positive in positive-true logic; negative in negative-true logic). Usually refers to electrical signals, like the RS-232-C signal Clear To Send, etc.

Asynchronous: Having a variable time interval between characters.

Asynchronous Communications Interface Adapter (ACIA): In the SSC, a single chip (Synertek 6551 or equivalent) that converts data from parallel to serial form and vice versa, and handles serial transmission and reception and RS-232-C signals, under the control of internal registers set and changed by SSC firmware.

Baud: A unit of signalling speed equal to the number of discrete conditions or signal events per second. With the SSC, for example, using a data format of 1 start bit, 7 data bits, 1 parity bit and 1 stop bit (10 bits in all), 300 baud is approximately equal to 30 characters per second.

Binary: A number system with two digits, "0" and "1," with each digit position moving from right to left representing a successive power of two. For example, 1 represents decimal 1; 10 represents 2; 100 represents 4; 1000 represents 8, etc.

Bit: A BInary digiT, either a 0 or a 1.

BREAK: A 0.233 second SPACE (0) signal sent over a communication line to interrupt the sender. This signal is often used to end a session with a timesharing service.

Carriage Return (CR): An ASCII character (decimal 13; Appendix D) that ordinarily causes a printer or display screen to place the subsequent character on the left margin. On a manual typewriter, this movement is combined with linefeed (the advancement of the paper to the next line). With computers, carriage return and linefeed are separate, causing hair-raising problems for the user.

Carrier: The background signal on a communication channel that is modified to "carry" the information. Under RS-232-C, the carrier signal is equivalent to a continuous MARK or 1; a transition to 0 then represents a start bit.

Character: Any symbol that has a widely understood meaning. In the ASCII code, letters, numbers, punctuation marks, and so on, are all characters (Appendix D).

Chip: A tiny wafer of silicon, with conductive metallic impurities, that has layers of microscopic circuits etched on it.

Clear To Send (CTS): An RS-232-C signal from a DCE to a DTE that the SSC keeps false until the DCE makes it true, indicating that all circuits are ready to transfer data.

Command Character: An ASCII character, usually <CTRL-A> or <CTRL-I> (Appendix D), that causes the SSC firmware to interpret subsequent characters as a command.

Command Register: An ACIA location (at hexadecimal address $C08A+s0) that stores parity type and RS-232-C signal characteristics.

Communications Interface Card (CIC): An Apple II interface card designed to connect the Apple II to a device via a DCE.

Communications Mode: An operating state in which the SSC is prepared to exchange data and signals with a DCE.

Control Character: Any character generated by holding down the key marked CTRL while pressing some other key.

Control Register: An ACIA location (at hexadecimal address $C08B+s0) that stores data format and baud rate selections.

Daisy Chaining: A method of passing incoming signals and data from one peripheral connector slot to another, such as from the SSC slot to a slot containing an 80-column-display card.

Data Bit: With the SSC, one of 5 to 8 bits representing a character.

Data Carrier Detect (DCD): An RS-232-C signal from a DCE to a DTE (such as the Apple II) indicating that a communication connection has been established. The SSC's internal circuits hold DCD false until the external device sets DCD true.

Data Communication Equipment (DCE): As defined by the RS-232-C standard, any device that transmits or receives information. Usually this is a modem. However, when a Modem Eliminator is used, the Apple II looks like a DCE to the other device, and the other device looks like a DCE to the Apple.

Data Conversion: Changing of data from parallel to serial form or from serial to parallel form.

Data Format: The form in which data is stored, manipulated or transferred. Serial data transmitted and received by the SSC has a data format of: one start bit, 5 to 8 data bits, an optional parity bit, and one, one and a half, or two stop bits.

Data Set Ready (DSR): An RS-232-C signal from a DCE to a DTE indicating that the DCE has established a connection.

Data Terminal Equipment (DTE): As defined by the RS-232-C standard, any device that generates or absorbs information, thus acting as a terminus of a communication connection.

Data Terminal Ready (DTR): An RS-232-C signal from a DTE to a DCE indicating a readiness to transmit or receive data.

Default Value: A value that is assumed or set in the absence of explicit instructions otherwise.

Device: A piece of equipment; usually a printer, plotter, terminal or computer. When the jumper block is in the MODEM position, the SSC expects the device to be a DCE (such as a modem).

Echo: To send an input character to a video screen, printer, or other output device. On a typewriter, what we strike on the keyboard appears on the page in the same step. With a computer, these two steps are controlled separately.

Electromagnetic Interference (EMI): Electrical or magnetic signals or noise that disturbs the operation of radio or television receivers. For example, a hair dryer often creates EMI that fuzzes up the picture on a nearby television set.

Emulation Mode: A manner of operating in which one computer or interface imitates another. For example, in SIC P8 Emulation Mode, the SSC acts very much like an Apple II Serial Interface Card with the P8 version of firmware.

ENQ: An ASCII character (decimal 5; Appendix D) used in the ENQ/ACK protocol (SIC P8A Emulation Mode).

ETX: An ASCII character (decimal 3; Appendix D) used in the ETX/ACK protocol (SIC P8A Emulation Mode).

Even Parity: Use of an extra bit set to 0 or 1 as necessary to make the total number of 1 bits an even number. For example, the 7-bit ASCII code for the letter A (1000001) has two 1 bits; for even parity, the transmitting device appends an eighth bit equal to 0 so that the total number of 1 bits remains even. The receiving device can count 1 bits as a way of checking for transmission errors.

False: Zero or negative voltage in positive-true logic; positive voltage in negative-true logic. Absence of an arbitrary signal or condition.

Firmware (FW): Software that resides in ROM and so is relatively unchangeable (firm) compared to software in RAM.

Form Feed (FF): An ASCII character (decimal 12; Appendix D) that causes a printer or other paper-handling device to advance to the top of the next page.

Framing Error (FRM): Absence of the expected stop bit(s) on a received character. The ACIA records this error by setting bit 1 (FRM) of its Status Register to 1. The ACIA checks and records each framing error separately: if the next character is OK, the FRM bit is cleared.

Full Duplex: Capable of simultaneous two-way communications.

Half Duplex: Capable of communications in one direction at a time.

Handshake : A kind of communication protocol in which the receiving device, when it has successfully gotten a character or block of characters, sends back an acknowledging signal, thereby triggering the next transmission.

Hardware: The actual physical switches, wires, chips, PC boards, and so on, of a computer system.

Header: A cable connector mounted on a PC board.

Hexadecimal: A numbering system that uses 16 digits; usually these are represented by the ten decimal digits, 0 through 9, plus the letters A through F (A representing decimal ten, F representing decimal fifteen, etc.). Each hexadecimal digit can represent a string of four binary digits.

High-order Bit: See Most Significant Bit.

Initialization: The process of setting up initial values and conditions. In the SSC, the firmware finds out the switch positions and the current operating system, and uses these findings to initialize both the ACIA registers and the Scratchpad RAM locations for the slot the SSC is in.

Input: Data that flows from the outside world into the Apple II.

Interface: Some combination of hardware, firmware and software that makes possible the useful connection of two otherwise incompatible pieces of equipment.

Interrupt: A special control signal from an external source that diverts the Apple II from the program it is executing to a specific routine that handles the condition (such as a printer gone awry) that caused the interrupt.

Jumper Block: In the SSC, a plastic plug with pins connected in such a way that it passes RS-232-C signals between the SSC and the external device either unchanged (MODEM position) or permuted in the manner of a Modem Eliminator (TERMINAL position).

Least Significant Bit (LSB): The right-hand bit of a binary number as written down; its positional value is 0 or 1 (that is, 0 or 1 times 2 to the 0 power).

Linefeed (LF): An ASCII character (decimal 10; Appendix D) that ordinarily causes a printer or video display to advance to the next line.

Local: Nearby; capable of direct connection using wires only.

Low-order Bit: See Least Significant Bit.

MARK Parity: A bit of value 1 appended to the high-order end of a binary number for transmission. The receiving device can then check for errors by looking for this value on each character.

Mode: Manner of operating. The SSC can operate in one of four chief modes, depending on the settings of switches SW1-5 and SW1-6: Printer Mode, Communications Mode, SIC P8 Emulation Mode, and SIC P8A Emulation Mode.

Modem: MOdulator/DEModulator; a DCE device that connects a DTE to communications lines. As used with the SSC, a device that exchanges RS-232-C signals with the ACIA to establish a communications connection, and then either converts data from RS-232-C voltages to RS-232-C tones for transmission, or performs the opposite conversion on received data.

Modem Eliminator: The physical crossing of wires that replaces a pair of modems for direct connection of two pieces of RS-232-C Data Terminal Equipment. In the SSC, the jumper block serves this purpose when installed in the TERMINAL position.

Most Significant Bit (MSB): The leftmost bit of a binary number as written down. This bit represents 0 or 1 times 2 to the power one less than the total number of bits in the binary number. For example, in the binary number 10000, the 1 represents 1 times 2 to the fourth power, or sixteen.

Odd Parity: Use of an extra bit set to 0 or 1 as necessary to make the total number of 1 bits an odd number. For example, the 7-bit ASCII code for the letter A (1000001) has two 1 bits; for odd parity, the transmitting device appends an eighth bit equal to 1, making the total number of 1 bits odd. The receiving device can check for transmission errors by counting 1 bits.

Output: Data that flows from the Apple II to an external device.

Overrun (OVR): A condition that occurs when the Apple II processor does not retrieve a received character from the Receive Data Register before the subsequent character arrives. The ACIA automatically sets bit 2 (OVR) of its Status Register; subsequent characters are lost. The Receive Data Register contains the last valid data word received.

P8: One of two types of Programmable ROM (PROM) installed in the Apple II Serial Interface Card. This PROM performed batch moves, but had no provision for software handshaking.

P8A: One of two types of Programmable ROM (PROM) installed in the Apple II Serial Interface Card. This PROM provided the ENQ/ACK software handshaking required by several types of printers.

Parallel Interface: A connection between two devices where there is a separate wire for each bit of a character, so that an entire character can be transferred in a single instant.

Parity: Maintenance of a sameness of level or count, usually the count of 1 bits in each character, for error checking. In the SSC, the ACIA has a register that stores the type of parity selected (none, odd, even, MARK or SPACE). It automatically generates the parity bit when transmitting, and both checks and discards parity bits appended to received characters.

Parity Error (PAR): Absence of the correct parity bit value in a received character. The ACIA records this error by setting bit 0 (PAR) of its Status Register to 1.

Peripheral Connector Slot: One of eight 50-pin slots inside the Apple II case near the back. Within certain restrictions, each slot can contain add-on memory, an adapter for 80-column display, or an interface to an external device.

Polarized Header: On the SSC, a 10-pin female connector for the internal cable; this connector has a slot on one side that receives a "key" on the cable's male connector.

Printed Circuit (PC) Board: A sheet of stiff nonconductive material with one or more thin layers of metal bonded to it. Unwanted areas of this metal are etched away, leaving the paths of the desired circuits. Electronic components can then be soldered to the board. Small PC boards are also called cards.

Printer Mode: An operating state in which the SSC is prepared to exchange data and signals with another DTE (such as a printer).

Protocol: A predefined exchange of control signals between devices enabling them to prepare for coordinated data transfer.

Radio Frequency Interference (RFI): Electromagnetic interference occurring at frequencies used for radio communications.

Random Access Memory (RAM): A series of storage locations that can be accessed directly (by means of horizontal and vertical coordinates) for both reading and writing.

Read Only Memory (ROM): A series of storage locations that can be read but cannot be written to; this protects the programs and data in the ROM from alteration or destruction.

Receive Data Register: A read-only register in the ACIA (at hexadecimal location $C088+s0) that stores the most recent character successfully received.

Remote: Too distant for direct connection via wires or cables only.

Request To Send (RTS): An RS-232-C signal from a DTE to a DCE to prepare the DCE for data transmission.

Ring Indicator (RI): An optional RS-232-C signal from a DCE to a DTE that indicates the arrival of a call.

RS-232-C: A standard created by the Electronic Industries Association (EIA) to allow devices of different manufacturers to exchange serial data--particularly via telephone lines. The ACIA in the SSC implements all the required primary RS-232-C signals. These signals are true when at 0 volts.

Scratchpad RAM: Eight locations in the Apple's memory reserved for each of the 8 peripheral connector slots (64 bytes in all).

Secondary Clear To Send (SCTS): A secondary RS-232-C signal that some printers use instead of Clear To Send.

Serial Interface: A connection in which all the bits of a character are sent along a single wire one after the other.

Serial Interface Card (SIC): An Apple II product designed to connect an RS-232-C device directly to the Apple II.

SIC Emulation Mode: A state of operation in which the SSC imitates an Apple II Serial Interface Card.

SPACE Parity: A bit of value 0 appended to a binary number for transmission. The receiving device can look for this value on each character as a means of error checking.

Start Bit: A transition from a MARK signal to a SPACE signal for one bit-time, indicating that the next string of bits represents a character.

Status Register: An ACIA register (hexadecimal location $C089+s0) that stores the state of two of the RS-232-C signals and of the Transmit and Receive Data Registers, as well as the outcome of the most recent character transfer.

Stop Bit: A MARK signal following a string of data bits to indicate the end of a character.

Super Serial Card (SSC): The interface card described in this manual. It is called "super" because it can simultaneously transmit and receive data in one of 35 formats at any of 15 speeds, honor several software protocols, communicate directly with either DTE or DCE, change operating characteristics in response to software commands, and dovetail with the chief operating environments offered with the Apple II.

Terminal: An input/output device, usually made up of a keyboard and video display and sometimes including its own printer and magnetic storage devices, that can act as a separate and even remote site for data transfer with a computer system.

Terminal Mode: An operating state of the SSC in which the firmware bypasses the Apple II's central processor, and makes the Apple act as a simple terminal capable of generating all of the ASCII characters.

Transmit Data Register: A write-only register in the ACIA (at hexadecimal location $C088+s0) that holds the current character to be transmitted.

True: Positive voltage in positive-true logic; zero or negative voltage in negative-true logic. Assertion of an arbitrary signal or condition.

XOFF: An ASCII character (decimal 19; Appendix D) sent by a receiving device to a transmitting device to halt transmission of characters.

XON: An ASCII character (decimal 17; Appendix D) used in the XON/XOFF protocol as a go-ahead character from the receiving device to the sending device after an XOFF has been sent to halt transmission.

# FIGURES AND TABLES

## Chapter 1
## GETTING STARTED

1 Figure 1-1 Photo of the Super Serial Card
2 Figure 1-2 Line Drawing of the SSC
3 Figure 1-3 Components of the Internal Cable and Clamp Assembly
4 Figure 1-4 Sliding the "Key" into the Groove
4 Figure 1-5 Internal Cable Attached Correctly to SSC

## Chapter 2
## PRINTER MODE

5 Figure 2-1 SSC Set for Printer Mode
10 Figure 2-2 SSC in Slot #1 and Clamp Assembly in Notch

6 Table 2-1 Commonly Used Switch Settings for Printer Mode
7 Table 2-2 Baud Rate Switch Settings
8 Table 2-3 Line Width and Video Switch Settings
14 Table 2-4 Printer Mode Commands
15 Table 2-5 Baud Rate Selections
15 Table 2-6 Data Format Selections
16 Table 2-7 Parity Selections
16 Table 2-8 Time Delay Selections
18 Table 2-9 Lowercase Character Displays

## Chapter 3
## COMMUNICATIONS MODE

21 Figure 3-1 SSC Set for Communications Mode
26 Figure 3-2 SSC in Slot #2 and Clamp Assembly in Notch

22 Table 3-1 Commonly Used Switch Settings for Communications Mode
23 Table 3-2 Baud Rate Switch Settings
23 Table 3-3 Data Format Selections
29 Table 3-4 Summary of Communications Mode Commands
30 Table 3-5 Baud Rate Selections
30 Table 3-6 Data Format Selections
31 Table 3-7 Parity Selections
32 Table 3-8 Time Delay Selections
33 Table 3-9 Lowercase Character Displays
35 Table 3-10 Special ASCII Character Generation
35 Table 3-11 Terminal Mode Commands

## Chapter 4
# HOW THE SSC WORKS

39 Figure 4-1 Parallel Data Transfer
39 Figure 4-2 Serial Data Transfer
39 Figure 4-3 Parallel-to-Serial Data Conversion
40 Figure 4-4 RS-232-C Serial Data Format
42 Figure 4-5 An RS-232-C Setup with Modems
43 Figure 4-6 An RS-232-C Setup with a Modem Eliminator
43 Figure 4-7 SSC Operating Modes
44 Figure 4-8 SSC Configurations
45 Figure 4-9 Overall Block Diagram of the SSC

38 Table 4-1 Binary and Decimal Digits and Quantities
41 Table 4-2 RS-232-C Signals as Interpreted by the Sender
41 Table 4-3 RS-232-C Signals as Interpreted by the Receiver
46 Table 4-4 SSC Address Remapping
47 Table 4-5 Registers in SSC Peripheral I/O Space

## Appendix A
# FIRMWARE

50 Table A-1 I/O Routine Offsets and Registers under Pascal 1.1
51 Table A-2 Bytes Used for Device Identification
51 Table A-3 Device Class Digit
52 Table A-4 Memory Usage Map
52 Table A-5 Zero-Page Locations Used by SSC
53 Table A-6 Scratchpad RAM Locations Used by SSC
54 Table A-7 SSC Registers in Peripheral Card I/O Space
55 Table A-8 Monitor ROM Entry Points Used by SSC
55 Table A-9 BASIC Entry Points Used by SSC
56 Table A-10 Pascal 1.0 Entry Points Used by SSC
57 Table A-11 Pascal 1.1 Offsets Used by SSC
57 Table A-12 SSC Special Firmware Locations

## Appendix B
# APPLE INTERFACE CARD EMULATION

93 Table B-1 SIC Switch Settings, PEEKs and POKEs, Part I
94 Table B-2 SIC Switch Settings, PEEKs and POKEs, Part II

## Appendix C

# SPECIFICATIONS AND SCHEMATICS

98 Table C-1 Connector Pin Assignments
99 Table C-2 Jumper Block Wiring

## Appendix E

# TROUBLESHOOTING HINTS

106 Table E-1 Problems Detected at the Device
107 Table E-2 Problems Detected at the Apple

## Appendix F

# ERROR CODES

109 Table F-1 STSBYTE Bit Definitions
110 Table F-2 Error Codes and Bits

# INDEX

## A

A register 50
ACIA 45, 47, 48, 91, 95, 96, 97
  function 47
  registers 49, 54
  status register 109
ACK 91, 94, 102, 106
address
  bus 45
  lines 46
  mapping 46
  space 46
addressing logic 45, 46
answer modem 42
Apple II Communications Card (see CIC)
Apple II Communications Interface Card (see CIC)
Apple II Parallel Cards 96
Apple II Serial Interface Card (see SIC)
APPLE SSC: 8, 12, 27
Applesoft 36, 98
ASCII 24, 34, 38, 95, 96
  code table 101-104
  special characters 35, 36, 101
assembly language 11, 27, 98
Asynchronous Communications Interface Adapter (see ACIA)

## B

B command 35, 36
BASIC 8, 11, 12, 17, 18, 19, 27, 31, 33, 36, 92, 101, 104
  entry points 55
  error codes 109, 110
  protocol 50
batch moves 95
baud rate 6, 15, 22, 30
  selection 15, 30
  switch settings 7, 23, 47, 91, 92, 93, 98
binary 37, 101
  data 24, 38
binary/decimal representation 38
bit 7, 23, 37
  data 30, 40, 93
  parity 40
  start 40
  stop 30, 40, 92, 94
block
  diagram, SSC 45
  moves 91
branch table locations, Pascal 1.1 50
break signal 36
buffer 45, 47
bus
  address 45
  data 45, 48
  parallel 48
byte 38
  device signature 51

## C

cable
  connector 10, 26
  external 1, 10, 26
  internal 1, 9, 24, 45
  socket 2
capitalize 34
carriage return delay 7, 17, 94, 95, 96
carrier
  lost 110
  signal 42
chaining 34
character
  displays 33
  enquire 95
characters
  echo on screen 34
  lowercase 34, 102
  uppercase 34, 102
  capitalize 34
CIC 36, 91, 96
clamp assembly 2, 3
Clear To Send (see CTS)
code 38
column overflow 17
command
  character
    change 13, 28
    Communications Mode 28, 102

    Printer Mode 12, 102
    send 12
  data format 15
  format 12, 27
    Communications Mode 27-28
  register 45
  remote-control 102
  reset 15, 95
  set time delay 16
  summary, Terminal Mode 35
  translate 91
commands
  CIC 96
  Communications Mode 27, 29, 102
  Parallel Card 96
  Printer Mode 11, 14
  Terminal Mode 22, 35
communications 37
  mode 21-33, 91, 95, 96
Communications Card, Apple II (see CIC)
Communications Mode 22, 26
  command
    character 28
    summary 28-29
  commands 27
  control character 27
components SSC 45
configurations, SSC 44
connector
  pin assignments 98
  slots 9, 25, 98
control
  character
    communications mode 27
    suppress 18, 33
  logic 45, 46
  register 45
<CR> 7, 17, 94, 95, 96, 102, 107
<CTRL-A> 27, 102
<CTRL-I> 8, 12, 102
<CTRL-R> 28, 35, 96, 102
<CTRL-S> 28, 96, 102
<CTRL-SHIFT-M> 101, 103
<CTRL-SHIFT-N> 103
<CTRL-T> 28, 35, 96, 102
CTS 41, 42, 43, 47, 48, 95, 98, 99

# D

data 37
  ASCII 24
  binary 24
  bit 7, 15, 23, 24, 30, 40, 93
  bus 45, 48
  bus buffer 45
  conversion 39, 47
  format 7, 23, 28, 30, 40, 47, 91, 92, 93
    command 15
    RS-232-C 40
    selection 15, 23, 30
  input 48, 96
  output 48
  serial 48
  terminal 40
  transfer 47
Data Carrier Detect (see DCD)
Data Communication Equipment (see DCE)
Data Set Ready (see DSR)
Data Terminal Equipment (see DTE)
Data Terminal Ready (see DTR)
DB-25 connector 10, 26, 97, 99
  pin assignments 98
DCD 41, 42, 43, 47, 48, 95, 98, 99
DCE 41, 48, 105
decimal error codes 110
default parity 16
demodulator 41
device
  class digit 51
  identification 51
  remote 19, 96
  signature byte 51
DEVICE SELECT 46, 47
disable 12, 28
DOS 8, 11, 27
Dow Jones News & Quotes Reporter 22, 36
  setup program for 36
DSR 41, 42, 43, 48, 95, 98, 99
DTE 41, 42, 48, 105
DTR 41. 42, 43, 95, 98, 99

## E

- E command 31, 34, 35
- echoing 34, 35
- edge connector 2
- EIA 40
- 80-column-display 34
- Electronic Industries Association (see EIA)
- emulation
  - modes 91-96
  - old Serial Interface Card 91
  - P8 92
  - SIC 92, 102
- enable 12, 28
- enquire character 95
- enter Terminal Mode 35
- entry points
  - BASIC 55
  - hardware 49
  - I/O routine 50
  - monitor ROM 55
  - Pascal 1.0 55, 56
  - Pascal 1.1 55, 56
  - SSC 55
- environment, SSC 97
- error
  - codes 109-110
    - BASIC 110
    - Pascal 110
  - framing 109, 110
  - parity 109, 110
- ENQ 95, 102
- ENQ/ACK 102
- <ESC> 34, 35, 101-104
- <ESC>L 91
- <ESC>U 91
- ETX 91, 94, 95, 102, 106
- ETX/ACK 91, 94, 102, 106
- Expansion ROM, SSC 46, 52
- even parity 16, 31, 40, 92, 93
- external cable 1, 10, 26

## F

- F command 17, 31
- FCC rules 10, 26
- <FF> 14, 16, 17, 29, 32
- firmware 34, 47, 49, 109
  - entry points, Pascal 1.0 (SIC) 49
  - interrupt handling 50
  - listings 57-96
  - locations, special 57
  - memory usage 53
  - protocol, Pascal 1.1 49
  - SSC driver 46
- form feed delay 14, 16, 17, 29, 32
- format, data 92, 93
- framing error 109, 110
- full-duplex 35

## G

- generate
  - ASCII characters 35
  - <CR> 17, 95, 96
  - <LF> 8, 17, 24, 31, 92, 94
- generic signature 51
- ground 10, 26, 42, 43

## H

- half-duplex 35, 36, 95
- handshake 94, 95
- handshaking 19
- hardware 96
  - entry points 49
  - handshaking 19
- hexadecimal 101

## I

- IN# 14
- IDS 560 Paper Tiger 6
- indirect addressing 56
- input 37
  - data 48, 96
- installation, SSC 9
- Integer BASIC 36
- interface
  - receive 45
  - transmit 45
- internal
  - cable 1, 9, 24, 45
    - attachment 3
    - clamp assembly 2, 3
  - shielding 10, 26
- interrupt
  - handling 50
  - request 47
    - Pascal 1.0 50

I/O
  routine entry points 50
  scratchpad address 109
  SELECT 46
  space
    peripheral card 52
    registers in 54
  STROBE 46
IORESULT 109

J

jumper block 2, 5, 11, 21, 27, 42, 45, 48, 95, 99, 105
  wiring 99

K

keyboard 11, 18, 27, 33, 101, 102

L

<LF> 8, 17, 24, 31, 91, 92, 94, 102
line width 8, 92, 94, 96
linefeed (see <LF>)
listings, firmware 57-96
local 37
lowercase 14, 18, 29, 32-33, 34, 91, 92, 93, 95, 101, 102
  character displays 18

M

MARK parity 16, 31, 40, 101
mask <LF> in 17, 31
memory usage map, SSC 53
mode
  communications 21-33, 26, 91, 96, 102
  emulation 91-96
  P8 93
  P8A 93-94, 102, 106
  printer 5-19, 91, 92, 93-94, 102
  SSC operating 43
  terminal 22, 34-36, 96, 101, 102
modem 22, 26, 27, 41, 42, 105
  answer 42
  eliminator 5, 42, 43, 45, 48, 99, 105
  null 42, 48
  originate 42
MODEM 5, 21, 27, 48, 99
modulator 41
monitor
  Apple II 11
  ROM entry points 55

N

NEC 5510 Spinwriter 6
no parity 31
null modem 42, 48

O

odd parity 16, 31, 40
offsets, Pascal 1.1 57
originate 40
  modem 42
oscillator 45, 47
output 37
  data 48
override switch settings 27
overrun 109, 110

P

P8 91-95
  emulation POKEs 92
  ROM 92, 94, 95
P8A 91
  mode 6, 102, 106
  ROM 92, 94, 95
parallel
  bus 48
  card commands 96
  data 37, 38-39
  I/O card 52
parity 7, 15, 23, 30, 47, 92, 93
  bit 7, 23, 24, 40
  error 109, 110
  even 40
  MARK 40, 101
  odd 40
  selection 16, 31

  SPACE 40
Pascal 11, 12, 27
  error codes 109, 110
Pascal 1.0 49
  entry points 55, 56
  interrupt requests 50
Pascal 1.1 49
  branch table locations 50
  device
    class digit 51
    identification 51
    signature byte 51
  entry points 55, 56
  firmware protocol 49
  I/O routines 50
    offsets 50
  offsets 57
PEEK 91, 92, 93-94, 109
peripheral I/O space 49
physical characteristics, SSC 97
pin assignments 98
POKE 19, 91, 92, 93-94, 95
power supply 9, 25
PR# 14
preparing SSC, printer mode 5
printer(s) 6
  local 11
  using 11
Printer Mode 5-19, 91, 92, 93-94, 95
  command character 12, 102
  commands 11
    summary 13-14
  data format 7, 15
  switch settings 6
  using 11
protocol 102
  BASIC 50
  Pascal 1.1 firmware 49

## Q

Q command 35, 36
Qume 6
quit Terminal Mode 36, 102

## R

RAM 45, 49, 92
  scratchpad locations 53
receive
  interface 45
  register 42
Received Data (see RXD)
register
  command 45, 54
  control 45, 54
  receive 42
  status/reset 45, 54
  transmit 42, 54
  transmit/receive 45
registers
  A 50, 55-57
  ACIA 49, 54
  Pascal 1.1 50
  peripheral I/O space 47
  switch settings 45
  X 50, 55-57
  Y 50, 55-57
remote 37
  device 19, 22, 26, 27, 96
  terminal 34
remote-control commands 102
Request To Send (see RTS)
reset 27
  command 15, 95
  SSC 17, 31
RESET 46
<RETURN> 12, 27, 102
Ring Indicator (RI) 41
ROM 45
  SSC Expansion 46, 52
ROM/RAM
  address mapping 46
  space 46
RS-232-C 40, 43, 47, 48, 95, 105
  signals 40-43, 49, 98-99
RTS 41, 42, 43, 95, 98, 99
RXD 41, 42, 43, 98, 99

## S

schematic, SSC 45, 100
scratchpad RAM locations 53
SCTS 98, 99
Secondary Clear To Send (see SCTS)
selection
  baud rate 15, 30
  data format 15, 23, 30
  parity 16, 31
  time delay 16, 32

serial
  data 37, 39, 40, 48
  interface card 95
setting switches 6, 22, 92
settings, switch 6, 22, 93-94
shielding, internal 10, 26
SIC 91, 92
  emulation mode 92, 102
  firmware entry points 49
  P8A mode 102, 106
  switch settings 93, 94
6502 registers 49, 50, 55-57
slew rate 48
software compatability 98
SPACE parity 16, 31, 40, 101
special
  characters, ASCII 101
  circuits, SSC 97
specifications, SSC 97-98
specify screen slot 34
SSC 1, 91, 95, 96, 102
  block diagram 45
  cable connector 10
    preparation 21
  configurations 44
  connect
    printer 7
    terminal 8
  controlling 11
  driver firmware 46
  emulation 94
  entry points 50, 55-57
  environment 97
  Expansion ROM 46, 52
  firmware memory usage 53
  installation 9, 92
  lowercase 18
  main components 45
  operating modes 43
  peripheral card I/O space 52
  photo 1
  physical characteristics 97
  registers in I/O space 54
  reset 17, 31
  RS-232-C signals 99
  schematic 45, 100
  scratchpad RAM locations 53
  slot location 98
  special circuits 97
  specifications 97-98
  switch settings 93-94
  theory of operation 45
  unpacking 1
  using
    Communications Mode 27
    printer 11
    Printer Mode 11
    terminal 11
  zero-page locations 52
start bit 7, 23, 40
status
  byte (see STSBYTE)
  register, ACIA 109
status/reset register 45
stop bit 7, 15, 23, 24, 30, 40, 92, 94
STSBYTE 109
summary
  Communications Mode commands 28-29
  Printer Mode commands 14
  Terminal Mode commands 35
Super Serial Card (see SSC)
suppress
  characters
    control 33
    keyboard 18, 33
  <LF> in 17, 31
switch settings
  baud rate 7, 23
  change 14, 30
  Communications Mode 22
  line width 8
  override 12, 27
  Printer Mode 6
  SIC 93-94
  SSC 93-94
  video 8
switches 2
  Communications Mode 21-22
  setting 22, 92
  SSC 45
  state of 47
  SW1 48, 54, 56, 57, 92, 93
    SW1-1 through SW1-4 2, 7, 15, 23, 31, 92, 93, 106
    SW1-5 and SW1-6 2, 5, 21, 92, 93, 102, 115
    SW1-7 2, 8, 24, 48, 92, 99
  SW2 6, 22, 48, 54, 56, 57, 92, 93, 94
    SW2-1 2, 7, 15, 23-24, 31, 92, 93, 94, 106
    SW2-2 2, 7, 16, 23-24, 31, 92, 94, 106
    SW2-3 and SW2-4 2, 8, 23, 92, 94, 106, 107

    SW2-5 2, 8, 17, 24, 32, 92, 93, 106
    SW2-6 2, 8, 24, 48, 92, 107
    SW2-7 2, 8, 24, 48, 92, 99

T

T command 35
tab 19
terminal
  connecting 8
  local 11
  unintelligent 34, 35
**TERMINAL 5, 11, 21, 42, 48, 95, 99, 101, 105**
**Terminal Mode 22, 34-36, 101-104**
  **bypass 96**
  **change to 96**
  **commands 35**
  **enter 35, 102**
  **example 36**
  **quit 36, 102**
**theory of operation**, SSC 45
**time delay**
  **selection** 16, 32
**time-sharing** 34, 36
**translate** 94
  **command** 17, 31, 91
  **lowercase** 18
**transmit**
  **break signal** 36
  **interface** 45
  **register** 42
transmit/receive register 45
Transmitted Data (see TXD)
troubleshooting 105-107
  at Apple II 107
  at device 106
TXD 41, 42, 43, 98, 99

U

unintelligent terminal 34, 35, 36
uppercase 14, 18, 29, 33, 34, 91, 92, 102

V

video on/off 8, 92, 94, 96

W

wiring, jumper block 99

X

X command 17, 31, 35, 106
X register 50, 55-57
XOFF 35, 102
  recognition 18, 33
XON 102
XON/XOFF 17, 19, 31, 33, 96, 102

Y

Y register 50, 55-57

Z

Z command 17, 18, 31
zero-page locations, SSC 52

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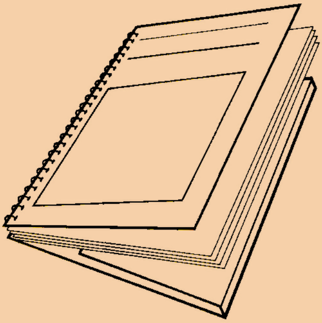
Tuck end flap
inside back cover
when using manual.



apple computer

10260 Bandley Drive
Cupertino, California 95014
(408) 996-1010

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